[Established 1832]

THE OLDEST RAILROAD JOURNAL IN THE WORLD

# AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE, INC.

140 NASSAU STREET, NEW YORK

J. S. BONSALL, Vice-President and General Manager

F. H. THOMPSON, anager.

Editors:

E. A. AVERILL. OSCAR KUENZEL.

SEPTEMBER, 1910

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# LOCOMOTIVE TERMINALS*

WILLIAM FORSYTH.

The most interesting example of American engine house practice is that in the classification yards of the Pennsylvania Railroad at East Altoona, Pa. Here the traffic from three divisions of the road is concentrated, classified and despatched. The freight tonnage passing through this terminal is claimed to be the largest handled by any single system of freight yards in the world. The total capacity of the yards is 10,500 cars.

The eastbound traffic is composed largely of loaded coal and coke cars, and the number of cars handled per month in this direction is: loaded, 61,308; empty, 1,306; total, 62,614. The westbound movement is composed largely of empty cars, with a total of 62,877 cars per month. In 1906 an average of 90 trains per day was received from the Pittsburg division and 60 from the Middle division, and the movement in one direction reached as high as one train every ten minutes for six hours. During the month of November, 1909, the engine movement at this engine house was as follows:

| | |
|---|---|
| Average number of locomotives despatched east and west in 24 hours | 243 |
| Maximum number despatched in 24 hours | 290 |
| Maximum number despatched in one hour including switch engines | 40 |

The trains are operated by consolidation locomotives, and on account of the grades on the eastern slope of the Allegheny mountains westbound trains require three engines, two in front and one as a pusher. Eastbound, the line follows a comparatively light gradient along the Juniata river, and here large trains can be handled by one consolidation engine. There are 35 switch engines, requiring 70 engine crews for day and night operation. During the month of November, 1905, there were handled over the ashpit a total of 64,497 engines. The number of men employed in the yards is 1,830. The number of engine men employed during the month averaged 1,012 and the number of men employed about the engine house, shops and coal wharf and on the motive power roll was 700.

Near the center of the length of the terminal is located a large engine house with ashpits, coal wharf, sand supply, a good-sized machine shop, storehouse and office, with bunk rooms overhead; also a power house, a fan house for heating, an oil house, and a toilet and locker house.

### THE ENGINE HOUSE.†

The engine house is in diameter and cross-section the largest structure ever erected for this purpose. It has an exterior diameter of 395 ft. and a turntable of 100 ft. There are 52 stalls 90 ft. deep. The main portion of the house is 65 ft. wide and 30 ft. high. On the outer circle there is a lean-to 25 ft. wide and 18 ft. high. The engines head in toward this lean-to and the smokejack is located alongside the main columns at the outer portion of the main building. The main portion of the house was made 30 ft. high to accommodate a traveling crane, but columns for supporting the crane have not been erected, as jib cranes secured to the main columns were found more desirable.

The turntable is operated by an electric motor. There are four drop tables, also operated by electric motors, two of them for driving-wheels, one large table for all wheels except the engine trucks, and another for pony truck wheels.

The coal wharf is a large structure arranged with a trestle approach having a grade of 3.88 per cent. The coal is dropped from hopper cars directly into bins and no cover is provided for the cars, as they are emptied entirely by gravity and no men are employed in the unloading. The storage structure is 32 ft. wide and 216 ft. long. A special gate and hood are used for regulating the flow of coal from the pockets to the tender. A steel gate drops below the floor of the pocket and is operated by a compressed-air cylinder.

At one end of the coal wharf is a sand house, where sand is dried in large stoves and descends through a grating to a reservoir, from which it is elevated by compressed air to the sand bins overhead, and flows by gravity to the engines.

Near the approach to the coal wharf are four ashpits, each 240 ft. long, two on each side of the wharf incline. Each pair is operated by an overhead 5-ton electric crane which spans four tracks, two of them over the ashpits for ash cars. Ashes are dumped from the engines into steel buckets which run on wheels on a track in the ashpit. These buckets are elevated by the crane and transferred to the ash car, where they are dumped. Beyond the ashpits at the extreme end of the coal wharf are inspection pits, 80 ft. long and 3 ft. deep, and connected by an underground passage extending under the coal wharf track.

### ENGINE HOUSE ORGANIZATION.

The work performed in an engine house includes almost everything in connection with locomotive repairs that does not require the locomotive to be sent to the general repair shop. No attempt will be made to itemize these repairs. The work which must invariably be performed periodically consists of boiler testing every six months; boiler washing, from once a week to once a month as necessity arises; staybolt testing each week; examination of smoke-box, draft arrangements and ash pans, each week; testing steam and air gauges each month; washing tenders each month; gauging height of pilots each week; gauging tank water scoops each trip; testing air brakes each trip; draining main reservoirs each week.

*Manner of Reporting and Performing Daily Work.*—When a locomotive arrives the first information the organization receives as to work necessary is in the engineer's report which he delivers at the inspection pit when the locomotive is turned over to the inspectors. Five inspectors are here employed, as the work must be done thoroughly in a minimum time, so that the hostler can move the locomotive to the ashpit and make room in the inspection pit for other locomotives waiting. One inspector examines the under-part of the locomotive and tender; one on each side inspects the outside parts, such as driving wheels, rods, steam chests, guides, crossheads and Walschaert valve gear; there are two air-brake inspectors, one to operate the brake valve and inspect the fittings in cab and air pump, and the other to inspect all other parts of the air and sanding equipment.

All defects found by the inspectors are entered upon regular blanks and transmitted, together with the engineer's report, to the gang leader in charge at the inspection pit, who decides whether it is necessary to send the engine to the house or whether the repairs are so slight that they can be made on the outside repair pits in connection with the outbound storage tracks. His decision is marked upon the report, and upon the steam chest of the locomotive, and the reports are forwarded to the work distributor's office by pneumatic tube‡ in 45 seconds. This saving in time over the 10 minutes ordinarily required by messenger is a decided advantage to the work distributor, as he is able to assign the work to various gang leaders, and have the necessary material ordered, before the locomotive arrives in the house or on the engine track.

While the inspectors are at work the lamps and torches are filled and trimmed by two lamp fillers. There is no further necessity for the engine house force to open the tool boxes, which are locked by the engineer, and the keys, together with his time card, delivered to the engine despatcher at the foreman's office. The engineer is then relieved of all responsibility and of the care of the locomotive.

The engine moves from the inspection pit to the ashpit, where

* Presented before the joint meeting of the A. S. M. E. and I. M. E. at Birmingham, England, July 25, 1910.

† For full description of this engine house and terminal, see AMERICAN ENGINEER, Feb., 1906, p. 46; Mar., 1906, p. 81.

‡ See AMERICAN ENGINEER, Feb., 1910, page 50, for illustrated description of this arrangement.

the firebox, ash pan and smokebox are cleaned. It then moves to the coal wharf, where the tender is filled with coal; and a little farther on reaches the sand house, where it receives a supply of sand and water. It then moves into the engine house or to the outbound storage tracks, as necessity requires. If it goes to the engine house the track number and the time of arrival are reported by telephone by the turntable motorman to the work distributor, who by this time has the work which was reported by the inspector and engineer subdivided and assigned to various gangs. After completing the work these gangs report the locomotive ready for service to the engine house office, where arrangement is made for the movement of the locomotive to the storage siding to await assignment to a train. If the locomotive does not go to the engine house it is moved directly from the sand house to the storage siding, and the necessary work is assigned to a gang located on the storage tracks to make light repairs, after which the locomotive is reported ready for service.

*Engine Tracing.*—At East Altoona there are sometimes as many as 200 locomotives within the engine house jurisdiction and it was found necessary to inaugurate some efficient method of locating them exactly at all times, so that men sent to make repairs will have no difficulty in finding any particular locomotive required. This is accomplished by telephone. Each time a locomotive moves to another locality the engine tracer in the foreman's office is advised as to where it came from and where it has been delivered, giving the number, the location on the track and the time in each case. When traffic at East Altoona is normal the engine house must deliver ready for service one locomotive every five minutes during the whole 24 hours of the day, as the engines for three divisions are here concentrated. It is vitally important that everything should run in absolute harmony as any interruption in this rapid flow would quickly result in a congestion on the road.

*Engine Despatching.*—After the engine tracer has been advised that a locomotive is placed on the storage track for service, he informs the engine despatcher, to whom the crew callers report. The engine despatcher is also in touch with the yardmaster and is the middle man between the engine house foreman and the yardmaster. As soon as the yardmaster receives information that he needs a locomotive and crew for a certain train of a given class at a certain time, he advises the despatcher, who immediately calls out a crew, and when they arrive assigns to them the locomotive selected, which is standing on the outbound storage track. A telephone system has been installed whereby all crews may be called. The houses of the engine men have been equipped with telephones connected with the engine house office, an arrangement which dispenses with messengers and enables the crews to be called very promptly.

The fireman usually arrives first, and after receiving his time card and keys he takes charge of the locomotive, relieving the engine watcher of any further responsibility, and immediately prepares a fire for road work. The engineer, upon arrival, after receiving his time card at the engine house office and inspecting the bulletin board to read any new orders, goes to the locomotive and oils the machinery, and then waits until he is given the proper signal to move out of the storage yard. The crews are usually called in sufficient time to prepare the locomotive properly for road work prior to leaving the storage track.

*Organization of Staff.*—For the operation of this locomotive terminal an elaborate organization has been worked out, based upon the principle that none but the heads of sub-departments shall report to or receive instructions from the foreman, his assistant or the work distributor. The responsibility of supplying material and the supervision of the workmen are placed directly upon these gang leaders, who are foremen of their respective gangs. Certain questions of discipline must be handled by the foreman personally, but questions relating to rates of pay, transfers, discipline, etc., ought to originate with the gang leaders, and their duties not be confined to giving out work to the men after the distributor has assigned it. This results in successful operation, but it also gives some dignity to the position of gang leader, and at the same time relieves the foreman of petty details.

The foreman of a large engine house should not be an ordinary shop man, but should have some outlook over and interest in the operating department. He should be a good disciplinarian, commanding the respect of his men, should display clear judgment and form conclusions quickly. He should be a good all-round organizer and capable of taking care of business promptly during rush hours. He should know how to make brief and intelligent reports and possess mechanical ability. He should be broad-minded enough to recognize that there is a commercial side to transportation, and should not be overburdened with office work. His assistants should possess sufficient ability to decide what work may be slighted or not done at all, and a locomotive still be safe to make one or more round trips.

The engine house foreman receives from the division master mechanic instructions pertaining to such matters as the number of men required, rates of pay, discipline, maintenance of his entire plant, and standards. He receives from the division superintendent instructions relating to crews and despatching of locomotives, and carries out such discipline of the engine crews as may be imposed by the division superintendent through the road foreman of engines. He must co-operate with the road foreman of engines concerning the condition of power and its performance on the road, and the amount of coal and oil consumed. He must carry out orders issued by the road foreman of engines concerning the assignment of locomotives and crews. At East Altoona the engine house operation is a continuous one throughout the day and night, and the night force is practically the same as the day force.

Reporting directly to the engine house foreman are the assistant day foreman and assistant night foreman. Reporting to assistant foremen for office work are the first clerk, who takes all the foreman's and the assistant foremen's dictation, and the second clerk, who has charge of all messengers and ordinary clerks who may be engaged in computing the time and earnings of the men and in getting together all the information required by the master mechanic's shop clerk and for properly keeping the records. Next in order is the engine despatcher, to whom report the engine tracer, the callers and the clerks who keep the records of engineers and firemen and of locomotives arriving and departing. The engine despatcher marks up the crew board, issues time cards to engine crews going out, and accepts and approves them upon their return.

Next in order reporting to the assistant foreman are the various gang leaders. First is the gang leader in charge of the machine shop. The work of his men is confined to machine and vise work, and they are not called upon to leave the machine shop and make repairs in the locomotive shop or storage yard except in cases of emergency. Their work is chiefly preparing and fitting the repair parts which the engine house employees apply to the locomotives. The gang leader in charge of the blacksmith shop has charge of all smiths and helpers, as well as the forces of flue welders and laborers in the engine house engaged in piecing flues and preparing them for locomotive boilers. The gang leader of the power plant has full charge of stationary engineers and firemen, electricians and wiremen. Another gang leader has charge of the ordinary helpers and sweepers in the engine house, who keep the shop property clean.

The foreman in charge of all employees actually handling locomotives, from the time they arrive at the terminal until they are turned out, also of all workmen engaged in the engine house or storage yard, is called the work distributor. Clerks reporting to his two assistants receive the engineers' and inspectors' work reports and copy the work required on slips of paper numbered consecutively and properly dated. These slips are then delivered to the gang leaders of the men who perform the work.

The men composing the gangs working on a piece work basis are divided into pools of three or four men, with leaders. The pool leaders are under the direction of gang leaders. When the earnings of three or four workmen are pooled it is found that each man is determined that the others should perform their fair share of work, and in case one man fails to do this the

remainder insist that the lazy or careless workman be taken out of their pool.

The gang leaders at the inspection pits are in charge of inspectors, lamp fitters and engine preparers, who handle the locomotives between the inspection and ashpits.

There are three assistant gang leaders in charge of the engine preparers. Assistant No. 1 has charge of all work in cleaning fires and placing the locomotives in the engine house or storage yard and of the ashpit men and crane operators who load cinders. Assistant No. 2 has charge of the coal gaugers and sand house men, turntable operators and men engaged in handling locomotives from the engine house to the storage yard. Assistant No. 3 has charge of the men handling locomotives in the storage yard and despatching them when ordered for service, including engine watchers, switchmen and engine timers.

Next reporting to the work distributor is the gang leader of boiler washers, whose men wash out the tenders, blow out, wash, fill and fire all boilers, and watch locomotives until they are removed from the engine house. Next is the gang leader of staybolt inspectors, whose men test staybolts and examine fireboxes and tubes. There is a gang leader of boiler makers, engaged in renewing tubes and staybolts, patching, testing and calking tubes, and general boiler work. A gang leader of engine cleaners has charge of men cleaning locomotives and tenders. There is a regular schedule for doing this work, and it is so arranged that the work is performed when the locomotives are receiving staybolt repairs or boiler washing. A gang leader of spongers is in charge of packing journal boxes and other work relating to lubrication. In the engine house there is a gang leader of machinists, who are engaged in setting valves, renewing packing and all other general machinist work on the locomotive proper. The gang leader of tank repairs is in charge of repairs to tenders, frames, tanks and couplers, of renewing truck wheels, and other tender repairs. The gang leader of air-brake repair men keeps in order the air brakes and sanding equipment.

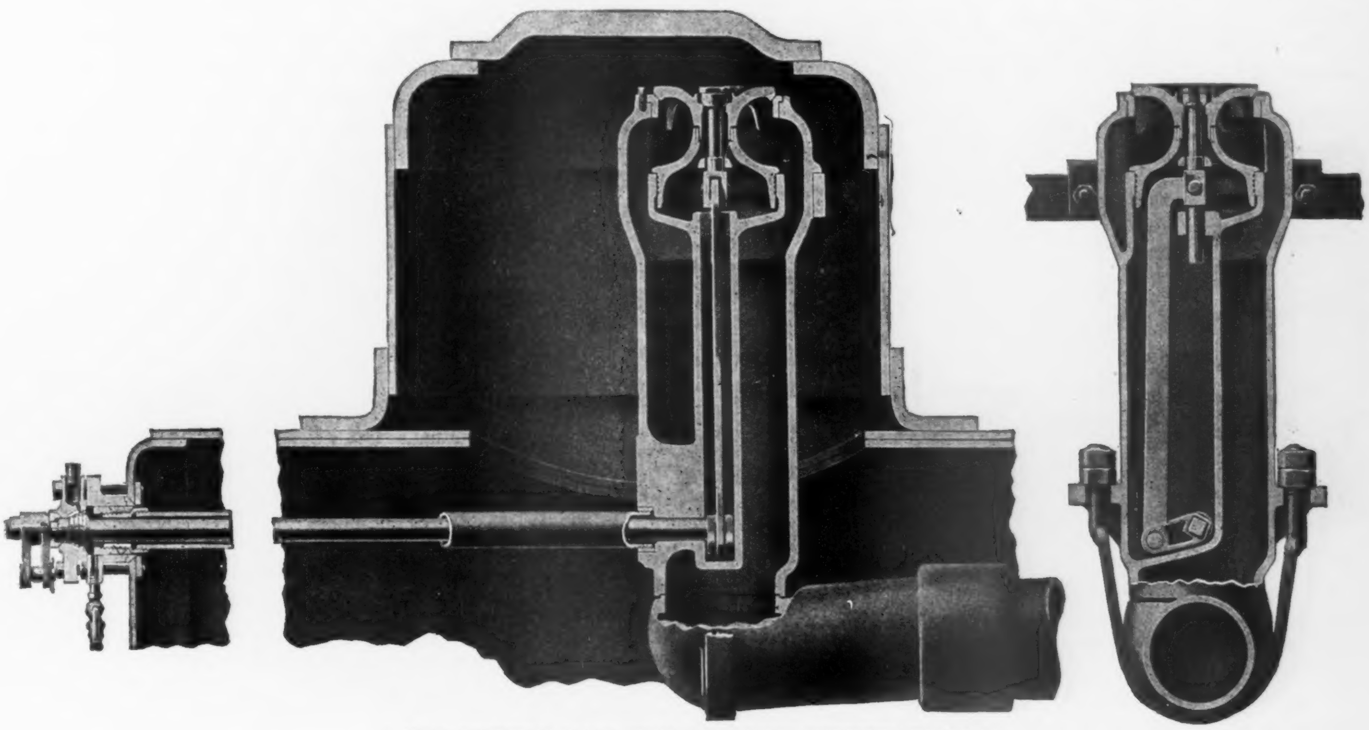
The gang leaders of men on piece work should have not more than ten or twelve men under them, with the exception of the gang on boiler work, which may require from one to four days to complete.

David W. Pye, formerly vice-president of the Safety Car Heating and Lighting Co., has been elected president of the United States Light and Heating Co., succeeding William H. Silverthorn, deceased.

## A NEW LOCOMOTIVE THROTTLE VALVE.

The throttle valve in use on most of the present locomotives, although it has rendered satisfactory service for a long time without any particularly apparent need for improvement, is generally admitted to possess some disadvantages that cannot be overcome without changing practically the entire design of the valve. Chiefly for this reason, and because these defects, when compared with those of other locomotive details, are not so prominent and may not appear very important, this matter has seldom received the careful attention justly due a device with so much influence upon the steam quality and consumption.

With the usual style of throttle valve it is almost impossible for inspectors to enter the steam dome without disturbing the dry pipe, or breaking steam joints. Usually a large amount of time is required to regrind the valve seats. There have been a number of engine failures on account of accidental disconnections in the throttle operating rigging inside of the boiler. And in addition there is always considerable lost motion in the mechanism due principally to the nature of its construction, which of course makes it impossible to regulate the valve opening as closely as is frequently necessary. This condition has recently led to the introduction of an auxiliary valve on some of the large Mallet compound engines with a further increase in the number of parts in the throttle valve and its operating arrangement.



A NEW THROTTLE VALVE THAT HAS MANY IMPROVED FEATURES.

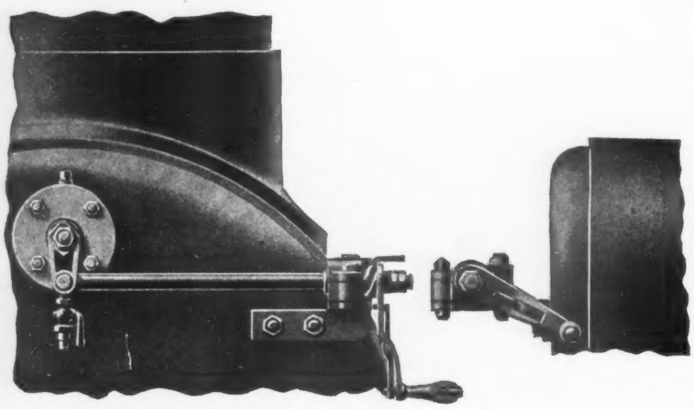
To overcome all these difficulties an entirely new design of valve has been invented by J. S. Chambers, superintendent of motive power of the Atlantic Coast Line Railroad. This valve, known as the Chambers throttle valve, and shown in section in the accompanying illustration, has had service tests of over three years with highly satisfactory results. It occupies less space than the old style of throttle valve and the general simplicity in design of both the valve itself and its operating mechanism, together with a number of other resulting advantages, render it a unique and desirable form of valve, and make it a strong rival of the present type, which will appeal strongly to the motive power department.

In this new design the throttle valve proper consists of a single balanced disc resting on top of the stand pipe, which is unseated by the upward movement of a balancing piston sliding in a finished cylindrical seat and telescoping at the top over the reduced end of the valve. The shoulder on the valve stem in its lowest position is just far enough below the shoulder on the

under side of the balancing piston to permit a slight raise before it begins to force the piston upward. This preliminary movement unseats a small balancing valve in the top of the main valve, permitting steam to enter the balancing chamber under the piston, and thus perfectly balancing the main valve before it is lifted for admitting steam.

The lifting rod fastened at the top to the stem of the balancing valve extends downward within the balancing chamber and connects through the interval crank with the operating shaft which extends backward through the wall of the stand pipe and through the back head of the boiler. Here the operating shaft is connected through the external crank, similar to and placed at right angles with the internal crank, to the transmission rod which extends horizontally along the back boiler head. This rod at its outer end passes through the operating screw, which is held in alignment by the babbited split box secured to a bracket on the boiler. The operating screw is free to rotate upon the transmission rod, but it travels longitudinally in the screw box and imparts this motion to the transmission rod through a collar on one side of the screw and washers adjusted for lost motion and locked on the end of the rod by two nuts, on the other side. The screw and operating handle are riveted together and travel as one solid piece.

The part of the operating shaft within the boiler is surrounded by a pipe casing which is threaded on the inner end



REGULATOR USED WITH NEW THROTTLE VALVE.

into a steam-tight bushing in the stand pipe wall, and on the outer end to an expansion sleeve packed into the stuffing box with metallic packing (to allow for unequal expansion). It will be seen that with a closed throttle the inner end of the operating shaft and the annular space between the shaft and the casing are free from steam pressure unless there is a leak at the throttle valve, balancing valve, or at some interior connection of the stand pipe. Such leakage admits steam to the balancing chamber and ultimately to the drain chamber at the stuffing box, and can easily be detected by opening the test and drain cock, which may also be utilized for blowing out steam occasionally to remove any mud that may find its way into the pipe.

The valve handle in normal position for closed throttle extends away from the operator and is latched to prevent accidental opening. Turning the handle downward and backward draws the transmission rod to the right, rotates the operating shaft, and thus opens successively the balancing valve and the throttle. The amount of throttle opening is indicated by the position of the handle and is limited by a stop on the screw box limiting the handle travel.

As the balancing valve opens, admitting pressure to the balancing chamber, the outward thrust upon the end of the operating shaft is distributed over a number of annular bearing shoulders turned on the operating shaft and working against a babbited bearing in the packing gland, which also serves the purpose of preventing the escape of the steam or condensation that works its way into the back end of the operating shaft casing while the throttle is open. The stuffing box is bolted into place in the usual manner and fitted with a ground, ball joint to conform to any slope of the back boiler head.

The construction of the Chambers valve has been simplified throughout with a view to minimizing inspection and repair expenses. The operating levers being entirely within the stand pipe which is set far toward the front of the steam dome, enables an inspector to enter the dome or make repairs without the usual necessity of having to break steam joints. Accidental interior disconnections in the operating gear are prevented by the absence of loose pins, the only pins used being those on the ends of the lifting rod, which are countersunk at their heads and riveted over on the ends. The forward end of the operating shaft centers itself in a square tapered socket in the internal crank, thus eliminating a pin at this point.

No greater clearance is required on top of the throttle valve than is necessary for the lift, and for this reason the valve may be placed high in the dome and thus deliver steam into the dry pipe with the minimum moisture. As the steam is required to pass through only one valve, there is little counter current or obstruction to impede its flow resulting in less wire drawing and more useful work from the steam. The main valve being single seated, not only does not require frequent regrinding as unequal expansion is never a factor in its operation, but the movement imparted by the steam flow makes it to a large extent self-grinding. Regrinding, when necessary, can usually be effected without removing the valve or seat. If, however, the combined balancing ring and seat is to be machined it may be quickly taken out of the standpipe upon the removal of only three screw bolts.

The Chambers valve is not subject to the troubles resulting from an unbalanced condition of the valve, as the main valve does not open until almost exactly balanced by the steam pressure under the balancing piston. It is evident, too, for reasons explained above, that the end thrust on the operating shaft cannot influence the valve opening. For these reasons the engineer has easy, complete and quick control of the steam admission without the necessity for locking the handle. The regulation of the valve is said to be so close that no special drifting valve is necessary in mountainous sections. Maintenance of an opening as small as 1/64 inch is practical, so that the engineer can admit the requisite small amount of steam to properly lubricate the cylinders and exactly balance the reciprocating parts while drifting down long hills.

The substitution of the rotary for the reciprocating operating shaft overcomes entirely the tendency in the present type of valve to open the valve unduly by forcing the stem outward, as in this case an outward movement of the operating shaft could not influence the regulating movement.

Neither the metallic packing on the end of the shaft casing, nor the babbited shaft bearing are subjected to frictional contact as a means of holding the operating parts. The small duty on the metallic and babbit packing is evidenced by the fact that on the locomotive in three years' constant service these packings did not require any attention whatever.

By referring to the illustrations, it is evident that with a closed throttle, the removal and replacement of the gland and shaft for adjustment or inspection are possible under steam pressure. The apparatus combines the throttle valve, throttle-box and standpipe in a single casting which is held rigidly in the steam dome at the top by a bolted connection and at the bottom is clamped to the dry pipe by a U strap bolt or by two hook straps.

The Chambers valve is manufactured by the Watson-Stillman Co., with offices at 50 Church street, New York.

SAFETY OF TRAVEL ON THE PENNSYLVANIA SYSTEM.—As compared with the records abroad, the Pennsylvania Railroad holds a better record, even, as regards the small number of passengers killed than the German state railroad system, noted for its safety. As regards the number of passengers injured, however, several of the European systems are still ahead of the Pennsylvania Railroad; but the record for safety, in general, is of the highest.—*Mach'y.*

# POWER CONSUMPTION OF THE MACHINE TOOLS AT THE READVILLE SHOPS.

### TESTS TO DETERMINE THE POWER REQUIRED FOR DRIVING THE VARIOUS INDIVIDUALLY DRIVEN AND GROUPED MACHINE TOOLS UNDER LIGHT AND FULL LOAD CONDITIONS AT THE READVILLE SHOPS OF THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

In the April issue of this journal, a very fully illustrated description of the locomotive repair section of the Readville Shop will be found on page 121. Included in this are illustrations giving the location, size, builder and size of motor driving every tool in the locomotive shop. Reference to those plans and photographs will clearly show the excellent arrangement of the tools in the shop and assist in a clear understanding of the tests which follow.

In the various departments of this whole shop there are 173 motors with a total capacity of 3,160 h.p., all of which are of General Electric manufacture. In the August issue of the *General Electric Review* there was given the results of various tests made on a large of these motors while in operation on the ordinary work.

The average motor load at the switchboard in the power house varies from 600 to 700 kw. and the average lighting and power load from 800 to 900 kw. The percentage of average load to total capacity of motors is thus about 30 per cent. The power factor during the day is about 69 per cent., increasing to 71 or 72 per cent. when the lights are in operation. The entire plant is operated by 25 cycle alternating current. The motors are all 750 r. p. m., 550 volt, Form K induction, with the exceptions as noted in the following table of tests:

**80 IN. DOUBLE WHEEL LATHE (PUTNAM), 10 H. P. MOTOR**

| Load | Kilowatt Input |
|---|---|
| Rolling axle, speed 15 feet per min | 0.5—2.0 |
| Turning axle, 1/64 in. cut, 1/32 in. feed, speed 15 ft. per min. | 0.6—1.6 |

**90 IN. DOUBLE WHEEL LATHE (PUTNAM), 50 H. P. MOTOR**

| | |
|---|---|
| Running light | 2.4 |
| Full load | 28 |

Load consists of two heavy cuts on driving wheels, ⅜ in. feed, ⅜ in. cut, cutting speed 12 ft. per min. Kind of tool steel—Mushet high speed.

**7½ H. P. MOTOR USED TO MOVE TAIL STOCK**

| | |
|---|---|
| Moving forward | 1.8 |
| Moving backward | 1.8 |

**600 TON, 90 IN. WHEEL PRESS (POND), 25 H. P. MOTOR**

| | |
|---|---|
| Running light | 1.4 |
| Pressing 6 in. crank pin from driving wheel | |
| Average load | 2.3 |
| Maximum load when pin started | 3.5 |

Maximum pressure when pin started, 260 tons.

**36 IN. X 12 FT. PLANER (PUTNAM), 10 H. P. MOTOR**

| | |
|---|---|
| Running light | 1.8 |
| Forward, no load | 2.8 |
| Reverse | 22. |
| Back | 4.4 |
| Reverse | 18. |
| Forward under load | 3.6 |

Load: One 1/64 in. cut, 1/16 in feed on cast iron. Tool steel, Midvale. One 1/32 in. cut, 1/16 in. feed on steel. Tool Steel, Syrian. Forward 35 ft. per min. Backward 70 ft. per min.

**48 IN. X 16 FT. DOUBLE PLANER (WOODWARD & POWELL), 25 H. P. MOTOR**

| | |
|---|---|
| Running light | 2. |
| Forward, no load | 4. |
| Backward, no load | 4. |
| Forward, under load | 13. |

Load, two 5/16 in. cut, 1/32 in. feed on cast steel.
Tool steel—Mushet high speed.
Cutting speed—45 ft. per min.

**72 IN. X 12 FT. PLANER (POND), 25 H. P. MOTOR**

| | |
|---|---|
| Running light | 1.7 |
| Reverse | 20. |
| Forward, no load | 2.4 |
| Backward | 5. |
| Reverse | 10. |
| Forward, under load | 4.8 |

Load, 1 cut ½ in. with ⅛ in. feed on cast iron.
Tool steel—Mushet high speed.
Cutting speed—18 ft. per min.
Return feed—54 ft. per min.

**72 IN. X 30 FT. PLANER (PUTNAM), 35 H. P. MOTOR**

| | | |
|---|---|---|
| Running light | 3.4 | |
| Forward, no load | 4.8 | |
| Reverse | 32. | 5 tons on bed |
| Backward | 9.2 | 5 tons on bed |
| Reverse | 14.8 | |
| Forward, under load | 6.4 | |

Load, one ¼ in. cut, 1/16 in. feed on cast iron.
Tool steel—Mushet.
Speed forward—30 ft. per min.
Speed backward—65 ft. per min.

**CYLINDER BORER, 7½ H. P. MOTOR**

| | |
|---|---|
| Running light | 0.76 |
| 3 cuts ⅛ in by 1/16 in. feed | 4.8 |
| 5 cuts ⅛ in. by 1/16 in. feed | 5.6 |

On 3 cuts, cutting speed 17 ft. per min. Tool steel unknown.
On 2 additional cuts, cutting speed 25 ft. per min. Tool steel, one Mushet high speed; one Syrian.

**6 FT. RADIAL DRILL (BICKFORD), 5 H. P., 1500 R. P. M., MOTOR**

| | |
|---|---|
| Running light | 0.9 |
| ⅞ in. hole in cast steel | 1.9 |

Feed—½ in. per min.
Speed of drill, 74 r.p.m.

**5 FT. RADIAL DRILL (BICKFORD), 5 H.P., 1500 R.P.M. MOTOR**

| Load | Kilowatt Input | Speed of Drill |
|---|---|---|
| Running light | .48 | |
| One ⅝ in. hole in steel, feed 0.45 in. per min | 1.3 | 52 r.p.m. |
| Two ½ in. hole in cast iron, feed 0.16 in. per min | 1.5 | 24 r.p.m. |
| Two ¾ in. hole in steel, feed 0.375 in. per min | 2.4 | 20 r.p.m. |

**51 IN. BORING MILL (BULLARD), 7½ H.P. MOTOR**

| | |
|---|---|
| Running light | 1.8 |
| Two ¼ in. cuts, 3/32 in. feed, 40 ft. per min. on cast iron | 4.6 |

Tool steel—Mushet high speed.

**47 IN. BORING MILL (BAUSH), 10 H.P. MOTOR**

| | |
|---|---|
| Running light | 1.9 |
| One 7/32 in. cut, 1/32 in feed, 35 ft. per min. cast steel | 3. |
| One 3/16 in. cut, 3/64 in. feed, 40 ft. per min. cast steel | 3.5 |
| One 3/16 in. cut, 1/16 in. feed, 50 ft. per min. cast steel | 4. |

Tool steel—Mushet high speed.

**BUFFER AND GRINDER (RAWSON), 3 H.P. MOTOR**

| | |
|---|---|
| Running light | 0.4 |
| Grinding 6 in. steam pipe to surface | 0.5 |

**COLD SAW (NEWTON), 3 H.P. MOTOR**

| | |
|---|---|
| Running light | .6 |
| Cutting 6 in. cast iron | 3.2 |

Slow feed, 0.45 in. per min.
Saw 16 in. diam., 14½ r.p.m.

**FLUE CLEANER (RYERSON), 25 H.P. MOTOR**

| | |
|---|---|
| Rolling | 7.2 |
| Lifting | 17. |

Loaded with 308— 2 in. diam. tubes, 12 ft. long.

**NO. 5 PUNCH (HILLES & JONES), 5 H.P. MOTOR**

| | | |
|---|---|---|
| Running light | 0.7 | |
| Punching 9/16 in. hole in ¼ in. boiler plate | 1.3 | Max. |
| Punching 9/16 in. hole in 3/16 in. boiler plate | 1.2 | Max. |
| Punching 9/16 in. hole in 5/16 in. iron | 1.5 | Max. |
| Punching 9/16 in. hole in ½ in. steel | 2.32 | Max. |

22 punches per min.

**NO. 4 PUNCH (HILLES & JONES), 10 H.P. MOTOR**

| | | |
|---|---|---|
| Running light | .5 | |
| Punching 13/16 in. hole in ½ in. flange steel | 4. | Max. |

**NO. 9 PUNCH AND SHEAR (HILLES & JONES), 15 H.P. MOTOR**

| | | |
|---|---|---|
| Running light | 3. | |
| Punching 2 in. hole in ¼ in. boiler plate | 5. | Max. |
| Punching 2 in. hole in 1½ in. wrought iron | 22. | Max. |
| Shearing 4 in. by 2½ in. hammered iron | 10. | Max. |

**NO. 3 SHEAR (HILLES & JONES), 5 H.P. MOTOR**

| | | |
|---|---|---|
| Running light | 0.3 | |
| Shearing round steel ½ in. diam | 0.8 | Max. |
| Shearing round steel ¾ in. diam | 1.1 | Max. |
| Shearing boiler plate ⅝ in. by 2½ in | 2. | Max. |
| Shearing boiler plate ⅜ in. by 1½ in | 1.2 | Max. |

**SPLITTING SHEAR (LENOX MACHINE CO.), 7½ H.P. MOTOR**

| | |
|---|---|
| Running light | 0.4 |
| Cutting ¼ in. boiler plate | 1.7 |

Cutting speed—7.2 ft. per min.

**10 FT. BENDING ROLLS (HILLES & JONES), 10 H.P. MOTOR**

| | |
|---|---|
| Running light | 1.2 |
| Bending ½ in. boiler plate, average | 2.8 Max. 4.4 |

Boiler plate was 6½ ft. wide and was bent to a radius of 30 in. in 5 rollings.
Rolling speed—5.6 ft. per min.

**63 IN. BOSTON CUPOLA AND FORGE BLOWER, 30 H.P., FORM L INDUCTION MOTOR**

This blower furnishes air for one flange fire, two flue fires, and a four burner Ferguson annealing furnace, made by the Railway Materials Co.

| | |
|---|---|
| All full blast | 13.8 |
| Two flue fires only | 9.5 |

### NO. 7 BLOWER (STURTEVANT), BULLDOZER (AJAX), 35 H.P., 500 R.P.M. MOTOR

Blower furnishes air for 5 furnaces.

| | |
|---|---|
| Blower with 3 furnaces operating | 16.3 |
| Blower and Bulldozer | 28.3 Max. |

Bulldozer was making 2-90 deg. bends on ¾ in. by 3 in. iron.

### STURTEVANT BLOWER, 35 H.P. MOTOR

Blower furnishes air for one double furnace, four single furnaces and five double forges.

| | |
|---|---|
| 3 single furnaces at work<br>1 double furnace at work | 17.6 |
| 3 single furnaces at work<br>1 double furnace at work<br>1 double forge full vent | 18.6 |

### BLOWER (BUFFALO), EXHAUSTER (BUFFALO), FOR 20 FORGES AND 2 FURNACES, 50 H.P., 500 R.P.M. FORM L INDUCTION MOTOR

| | |
|---|---|
| 11 forges and 2 furnaces in operation | 21.5 |

### NO. 3 SHEAR (HILLES & JONES), 10 H.P. MOTOR

| | |
|---|---|
| Running light | 1. |
| Shearing 1½ in. wrought iron | 5.5 } Max. |
| Shearing 2¾ in. wrought iron | 6. } Max. |

### 5 FT. 6 IN. RADIAL DRILL (NILES, BEMENT & POND), 5 H.P. MOTOR

| | |
|---|---|
| Running light | 1.2 |
| Drilling ¾ in. hole in steel, feed 0.67 in. per min | 1.5 |
| Drilling 2½ in. hole in steel, feed 0.075 in. per min | 1.8 |

### MILL SHOP NO. 1

### SWING CUT-OFF SAW (ROGERS), 3 H.P. MOTOR

| | |
|---|---|
| Running light | 0.74 |
| Cutting 2 in. by 12½ in. spruce | 2.4 |

Size of saw—19 in.
Speed—2080 r.p.m.

### SWING CUT-OFF SAW (ROGERS), 3 H.P. MOTOR

| | |
|---|---|
| Running light | 0.9 |
| Cutting 5 in. by 8 in. hard pine | 6. } Max. |
| Cutting 2 in. by 10 in. hard pine | 5. } Max. |

Size of saw—18 in.
Speed—1840.

### RAIL SAW (NEWTON), 7½ H.P. MOTOR

| | |
|---|---|
| Running light | 0.56 |
| Sawing 6 in. steel rail, average | 1.6 Max. 2.4 |

Feed—0.21 in. per min.
28 in. saw, 5.15 r.p.m.

### RAIL BENDER (WATSON & STILLMAN), 15 H.P. MOTOR

| | |
|---|---|
| Running light | 1. |
| Bending 79 lb. rail to 24 ft., 11¼ in. radius | 8. |

Speed of rail—100 ft. per min.

### 15 IN. SLOTTER (DILL), 5 H.P., 1500 R.P.M. MOTOR

| | |
|---|---|
| Running light | 0.4 |
| One ¾ in. cut, 1/64 in. feed on steel | 0.9 |

Tool steel—Mushet high speed.
Strokes per minute—23.

### ELEVATOR, 5 H.P. MOTOR

| | |
|---|---|
| Motor running light | 0.56 |
| Elevator up with one man | Pump back on line |
| Elevator down with one man | 4.2 |
| Elevator up with 1400 lbs | 1.2 |
| Elevator down with 1400 lbs | 2.2 |

### 24 IN. EXTRACTOR, 3 H.P. MOTOR

| | |
|---|---|
| Extractor filled with oily waste | 0.96—0.88 |

Speed of extractor—1080 r.p.m.

### NO. 3 GAINER (WOOD), 10 H.P. FORM L INDUCTION MOTOR

| | |
|---|---|
| Running light | 2.4 |
| ½ in. by 1½ in. gain in hard pine | 4.4 |
| 2 in. by 4½ in. gain in hard pine | 7.2 |

### NO. 2 FORGING MACHINE (AJAX), 10 H.P. FORM L INDUCTION MOTOR

| | |
|---|---|
| Running light | 1.6 |
| Punching 5/16 in. hole in a 1 9/16 in. rivet | 5.0 Max. |

### NO. 5 FORGING MACHINE (AJAX), 20 H.P. FORM L INDUCTION MOTOR

| | |
|---|---|
| Running light | 3.7 |
| Loaded | 16.1 Max. |

Load consisted of gathering a 1⅞ in. hemispherical head on a 1⅛ in. rivet.

### GROUP (GALLERY), 7½ H.P. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 1 Two spindle irregular moulder (Carey) | Running light | |
| 1 39½ in. band saw (Carey) | Running | |
| 1 Double saw table (Carey) | Running | 7. |

When test was made saw was ripping 2 in. pine and saw bench ripping 2 in. oak.

### GROUP, 10 H.P. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 4 Flue cutters | 2 Running light<br>2 Running | |
| 1 Flue welder | Running | 4. |

### GROUP, 10 H.P. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 1 28 in. Vertical drill (Blaisdell) | Running | |
| 1 40 in. Vertical drill (Bement) | Running | |
| 1 38 in. Vertical drill (Prentice) | Running | |
| 2 34 in. Lathes (Putnam) | 1 Running | |
| 5 22½ in. Vertical drills (Barnes) | 1 Running | 6.2 |

### GROUP, 15 H.P. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 3 24 in. Lathes (Reed) | 2 Running | |
| 1 40 in. Vertical drill (Bement) | | |
| 1 42 in. Boring mill (Bullard) | Running | |
| 1 24 in. Shaper (Stockbridge) | | |
| 1 15 in. Slotter (Betts) | | |
| 1 18 in. Slotter (Putnam) | Running | |
| 1 30 ton Arbor press (Chambersberg) | | 8. |

### GROUP, 15 H.P. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 2 30 in. by 8 ft. planers (Woodward & Powell) | 2 Running | |
| 1 26 in. by 10 ft. milling machine, planer type (Becker-Brainard) | | |
| 1 5 ft. radial Drill (Bickford) | Running | |
| 2 No. 2 horizontal boring mills (Betts) | 2 Running | |
| 1 25 in. vertical drill (Barnes) | | 8. |

### GROUP (GALLERY), 15 H.P. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 1 24 in. lathe (Fitchburg) | | |
| 2 20 in. lathes (Schumacher) | 1 Running | |
| 4 13 in. lathes (Prentice) | 2 Running | |
| 5 18 in. lathes (Schumacher) | | |
| 4 2 ft. by 24 in. flat turret lathes (Warner & Swasey) | 2 Running | |
| 2 2 ft. by 24 in. flat turret lathes (Jones & Lampson) | 1 Running | |
| 1 40 in. vertical drill (Bement) | | |
| 1 25 in. vertical drill (Barnes) | | |
| 1 3 in. bolt cutter | | |
| 1 1½ in. bolt cutter (Acme) | | |
| 2 double bolt cutters (Acme) | 2 Running | Av. 12. |
| 1 double bolt cutter (Niles, Bement & Pond) | Running | Max. 24. |

### GROUP, 15 H.P. FORM L INDUCTION MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 1 trip hammer (Bradley) | Running | |
| 1 No. 2 emery grinder (Diamond Machine Co.) | Running | |
| 2 40 in. vertical drills (Bement) | 2 Running | |
| 1 Grindstone | | |
| 1 hammer (Bradley) | | |
| 1 No. 2 shear (Hilles & Jones) | | |
| 1 1½ in. forging machine (Ajax) | | |
| 1 2 in. forging machine (Ajax) | Running | Av. 13. |
| 1 3½ in. forging machine (Ajax) | Running | Max. 19. |

### GROUP, 25 H.P. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 2 30 in. boring mills (Bullard) | 1 Running | |
| 2 24 in. lathes (Reed) | 2 Running | |
| 2 18 in. lathes (Reed) | | |
| 1 24 in. turret lathe (Gisholt) | Running | |
| 1 30 in. planer (Woodward & Powell) | | |
| 1 16 in. shaper (Gould & Eberhardt) | | |
| 1 24 in. shaper (Stockbridge) | Running | |
| 1 16 in. shaper (Stockbridge) | | |
| 1 30 in. planer (Putnam) | | |
| 1 42 in. vertical milling machine (Hilles & Jones) | | |
| 1 double rod borer (Newton) | | 16. |

### GROUP, 30 H.P. FORM L INDUCTION MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 1 No. 300 hollow mortiser (Wood) | Running | |
| 1 No. 225 hollow mortiser (Greenlee) | Running | |
| 1 30 in. single planer (Rogers) | Running | |
| 1 30 in. single planer (Fay) | Running | Av. 22.2 |
| Heavy load. | | Max. 30.3 |

### GROUP, 35 H.P., 500 R.P.M. MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 2 irregular moulders (Wood) | 2 Running | |
| 1 60 in. three drum sander (Fay) | Running | |
| 1 42 in. three drum sander (Fay) | Running | |
| 2 grindstones | Running | |
| 1 42 in. band saw (Fay) | Running | |
| 2 turning lathes (Wood) | | |
| 1 dowel machine (Fay) | | |
| 1 rip saw | Running | |
| 2 copper sheathing machines | | 26.3 |
| Heavy load. | | |

### GROUP, 40 H.P. FORM L INDUCTION MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 1 No. 214 jointer (Invincible) | | |
| 1 Universal jointer (Fay) | Running | |
| 1 saw table (Roolston Engine Works) | | |
| 1 end tenoner (Berry & Orton) | | |
| 1 5 spindle borer (Wood) | Running | |
| 1 5 spindle borer (Greenlee) | Running | |
| 1 self feed rip saw (Wood) | | 20.3 |

### GROUP, 50 H.P., 500 R.P.M., FORM L INDUCTION MOTOR

| Machines | Load | Kilowatt Input |
|---|---|---|
| 1 chain mortiser (New Britain) | | |
| 1 buzz planer and drill (Fay) | | |
| 1 48 in. band saw (Fay) | Running | |
| 1 10 in. outside moulder (Wood) | Running | |
| 1 36 in. band saw (Atlantic) | | |
| 1 tenoner (Fay) | | |
| 1 double cabinet saw (Carey) | | |
| 1 tenoner | | 18.3 |

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COMPUTER, COAST AND GEODETIC SURVEY.—An examination will be held September 7th and 8th to secure eligibles to fill a position of computer at a salary of $1,200. This examination will be on a basis of pure mathematics and practical computations only. These examinations are held in various places throughout the country, and anyone wishing to apply should write to the U. S. Civil Service Commission, Washington, D. C., for application form No. 1312. The age limit is 20 years or over on date of examination.

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PASSENGER TRAVEL ON PENNSYLVANIA RAILROAD.—Figures compiled by the Pennsylvania Railroad system show that in 1908 and 1909 the various lines carried a total of 299,762,658 passengers over its 24,000 miles of track and only one passenger was killed as the result of a train wreck. These figures show that the chances of each passenger being killed in an accident is one in 300 million in two years and for each mile carried the chances are one in more than seven billion. During these two years but 370 passengers were injured in train wrecks.

## THE NEW FACTORY OF THE TRIUMPH ELECTRIC CO.

The Triumph Electric Co. was founded in 1889, the original factory on Second street, Cincinnati, Ohio, occupying about 8,500 square feet of floor surface. In 1895 the company removed to large and more commodious premises at the corner of Sixth and Baymiller streets with an approximate floor area of 40,000 square feet, which was ultimately increased to about 65,000 square feet.

Notwithstanding the fact that these premises did not lend themselves readily to the adoption of improved methods of manufacture, the sales of the company steadily advanced, and in the six years between 1900 and 1906 were more than doubled. In 1908 these quarters were completely outgrown, and it became imperative that a new factory be built. Therefore, in 1909 8½ acres of land at Oakley, a subdivision of Cincinnati, were purchased, and on this site there has been erected a thoroughly equipped and entirely modern factory. This particular site was chosen on account of its unsurpassed shipping facilities, and because of the extent of property available for future extensions.

The main building of the factory is 300 ft. long by 140 feet wide, and three stories high. The center bay open to the saw-tooth type of roof, is spanned by a 25 ton traveling crane with a 5-ton auxiliary hoist. The second floor gallery on either side is devoted entirely to the stores department. The third floor east bay is occupied by the switchboard department, the coil winding, commutator departments, and the armature winding department. Each of these is located immediately above the stores where the raw material and finished products are kept, so that handling is reduced to a minimum. On the west bay similar conditions prevail. The third floor gallery is occupied by the small tool department immediately above the stores. Both the east and west bay are provided with two freight elevators, and in addition the third floor on either side can be served by the overhead traveling crane.

All heavy machine work is performed on the first floor, which is paved with concrete, making a solid foundation for the heavy tools, and is easily kept clean. On the east side are located the punch department and small testing departments, where both A C and D C motors of small size are tested before shipment. The larger machines are placed on a special floor made up of Z sections and concrete at the front end of the building in close proximity to the outgoing railroad switch, where they are erected and tested.

INTERIOR OF THE TRIUMPH ELECTRIC COMPANY'S NEW SHOP.

All modern conveniences in the way of clothes lockers and wash rooms are provided for the men and are located at the main factory entrance in the northwest corner of the building.

In addition to the main building another building 240 feet long by 60 feet wide is situated at the west rear end of the main building in such a position as to eventually form one of the ells, which have been provided for in the planned extensions. Here are housed the pipe department, the blacksmith shop and the brass foundry.

In conjunction with four other factories located in the immediate vicinity, a large power plant has been erected, which supplies light, heat, power and compressed air to the various factories at a nominal charge. This station is equipped with Triumph generators of 300 k. w. capacity, each direct connected to Hamilton-Corliss-Cross compound engines, and orders have now been booked for an additional 600 k. w. unit.

The available floor area of the new shops is at least three times as great as formerly, and about $50,000 worth of new equipment has been purchased in order to take care of the increased business of the company. Of especial interest is a new machine built by the Morton Co. of Muskegon, Mich., which materially reduced the time required to machine large castings, and is the first of its kind to be installed in Cincinnati.

Every indication points to the fact that the present buildings, although three times as large as formerly, will not be adequate to house the business of the company in the near future, and it has already been decided to lengthen the main shop by 500 feet and to build six ells, each 240 feet long by 60 feet wide, at right angles to the main building on the west side. These additions will be commenced just as soon as the volume of business demands. In addition, a separate administration building will be erected in order to allow room for the expansion of the testing department, and a new pattern shop has already been considered.

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POOR'S MANUAL OF INDUSTRIES.—The first annual number of Poor's Manual of Industries, containing 2,317 pages of text and designed to perform a work similar to that of Poor's Manual of Railroads, is being issued. This book is remarkable not only for its scope, which is much greater than has heretofore been attempted, but also for the aggregate industrial figures presented in the introduction. The total capitalization of all industrial corporations reported is $18,873,000,000. The total capitalization of all railroads in the United States, according to the Manual of Railroads, is $17,234,000,000. The average rate of interest on bonds of industrial corporation is 5.27 per cent., as against 3.88 per cent. on railroad bonds. The average dividend rate on industrial stock is 4.02 per cent., as against 3.5 per cent. on railroad stock.

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INDIVIDUAL DRIVE FOR SMALL TOOLS.—Considerable difference of opinion has developed as to the advantages of individual versus group drives for machine tools, and while it is generally agreed that it is advantageous to have the larger tools individually driven, the agreement by no means extends to the smaller ones. Under certain conditions there is no question as to the advantages of the individual drive for small tools, as, for instance, where small tools are necessarily placed among larger ones, or to allow convenient placing of tools in the assembling departments. The cases where it would be advantageous to have small individually-driven tools are numerous.—*Chas. Fair before A. S. M. E. and A. I. E. E.*

# RECORD OUTPUT OF A CAR WHEEL LATHE

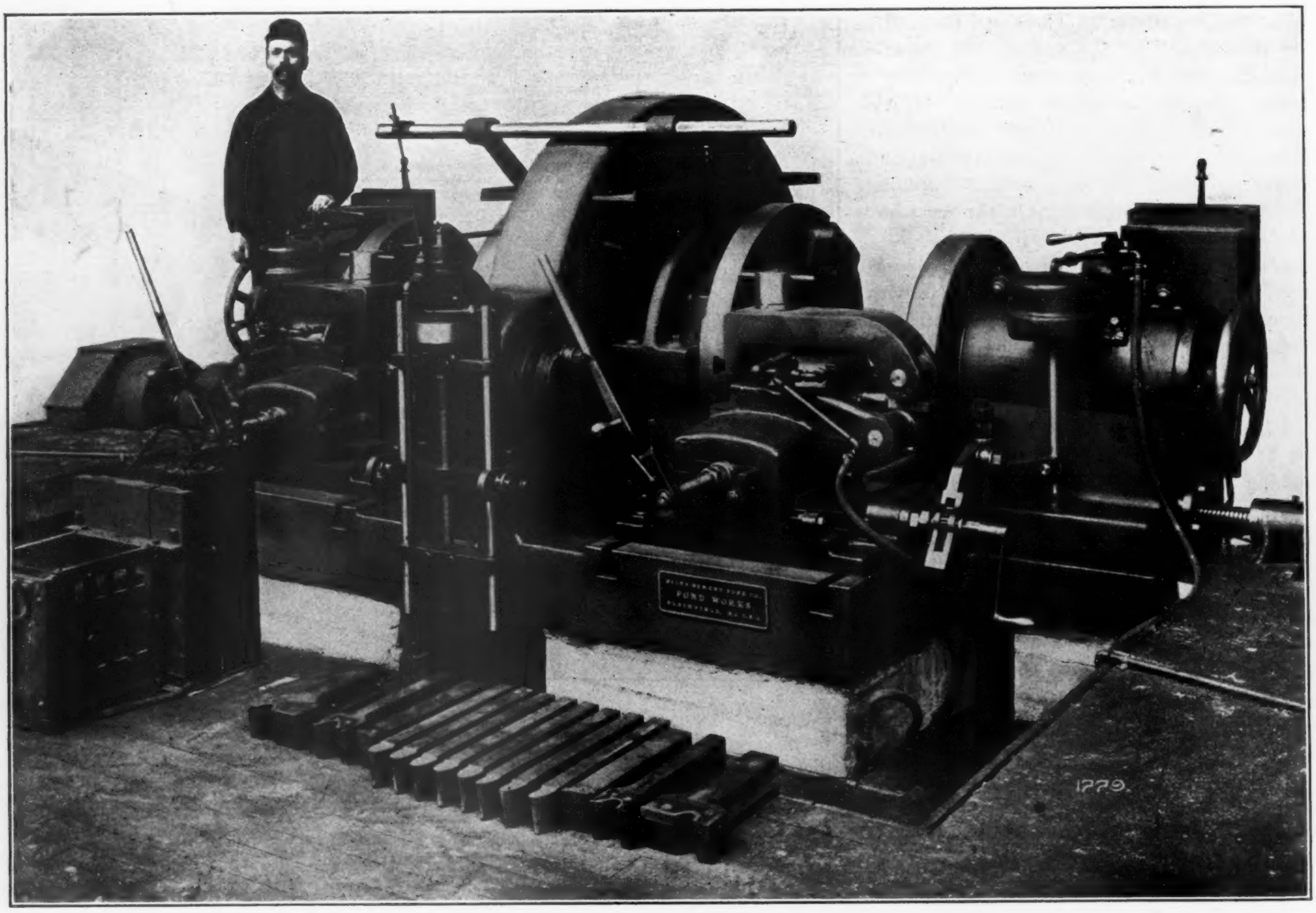
33 PAIRS IN 9 HRS. 53 MIN.

Recent improvements in the Pond 42-inch car wheel lathe have increased its speed of operation to a point where 33 pairs of 36-inch steel-tired wheels can be turned in less than 10 hours. In fact, this was recently accomplished at the West Albany shops of the New York Central by the workman who customarily operates the machine. The details of this day's work are given in the table on the next page.

Pneumatic devices and attachments of various kinds on the lathe are largely responsible for this record. These consist of a pneumatically operated tool post, air cylinders for moving the tail stock, air operated clamps for holding the tail stock in place and skids raised by air cylinders to bring the axle up to the centers. Automatic operation of the gear segment also assisted materially in increasing the speed of operation. All valves for operating the various air appliances are conveniently located within reach of the operator's platform.

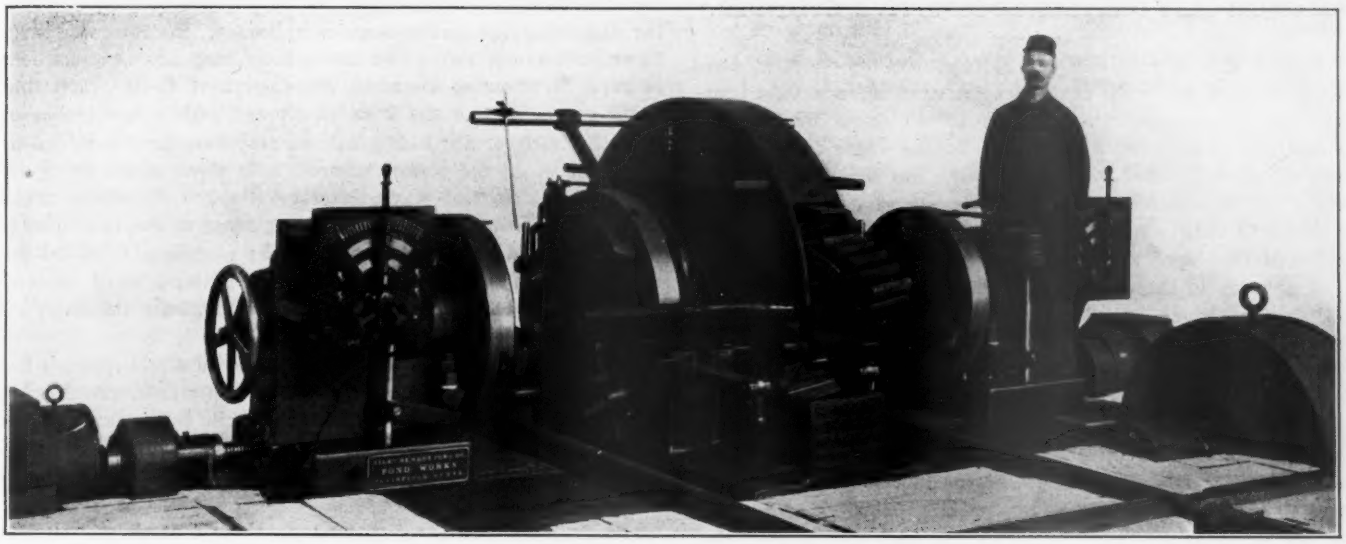
The new power tool seat will clamp the largest tools rigidly and instantaneously. The air cylinder which furnishes the power for clamping the tool is a part of the lower member of the tool rest. The piston working in the cylinder forces a wadge between a lower fixed roller and an upper roller on the lever end of the clamp itself. The strain on the tool incident to the cut is not carried back to the elastic medium in the cylinder. When the rollers are forced apart by the piston wedge, they remain in that position whether the pressure is maintained in the cylinder or not; thus making the clamp a positive lock. The rest is entirely open at the side and the tools are readily changed without any movement to the slide; in fact, with no extra manipulation of any kind. The power cylinder, being part of the tool rest, offers no obstruction to the view of the work.

The lateral pressure on the wheels, as a result of taking heavy roughing cuts, tends to cause the tailstocks to slide on the bed, necessitating the use of four heavy T-bolts to hold each tailstock in position after it has been adjusted. The time and labor incident to tightening and loosening these T bolts has been reduced to a negligible quantity through the use of pneumatic pistons on each tailstock. The downward thrust of the piston operates powerful levers on either side of the tailstock, the rocking movement of which draw up the heavy sliding T bolts and hold the tailstock securely in position.



POND 42-INCH CAR WHEEL LATHE WITH NEW ATTACHMENTS THAT HAVE GREATLY INCREASED ITS OUTPUT.

Improvised skids have heretofore been used to lift the axle to the position where the tailstocks could run to the centers. The wheels are now run into the machine on two light rails which extend to the center of the lathe; two pistons, operated by power and underneath the ends of the rails, raise the wheels with their axle to the centers of the face plates. They can be raised and lowered quickly and accurately by the simple movement of a valve. The rails are specially constructed to be as light as possible and are movable so that they will not interfere when cleaning out the chips.



VIEW SHOWING AUTOMATIC OPERATION OF THE GEAR SEGMENT.

The gear segment is automatically left in an open position when the wheels are rolled out of the lathe. The axle of the next pair of wheels, when it is rolled in, strikes a projection on the underside of the segment, tripping a latch, held in position by a spring, and forces the segment to drop into place. A heavy latch holds the segment in its working position until it is again released by the axle when the wheels are taken out. This not only greatly reduces the time required for putting the gear segment in and out of place, but eliminates all manual labor on the part of the operator.

On May 11, 1910, one of these lathes at West Albany was working on 36-inch Krupp and Paige steel-tired wheels and a careful and detailed record of its operation was obtained and is reproduced in the accompanying table. The net result was 33 pairs in 9 hrs. 53 min., or an average of less than 18 min. per pair from floor to floor.

| Pair No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Putting in lathe | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 3 | 2 | 2 | 4 | 2 | 2 | 2 | 4 |
| Roughing | 11 | 8 | 9 | 9 | 9 | 9 | 9 | 9 | 11 | 10 | 10 | 9 | 11 | 12 | 8 | 9 | 8 |
| Finishing | 5 | 6 | 4 | 3 | 5 | 4 | 6 | 4 | 7 | 5 | 5 | 5 | 5 | 8 | 4 | 5 | 4 |
| Taking out | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Time from floor to floor | 20 | 17 | 16 | 16 | 17 | 16 | 18 | 17 | 21 | 19 | 18 | 17 | 21 | 23 | 15 | 17 | 17 |
| Depth of cut | ¼ | ⅛ | $\frac{3}{16}$ | ¼ | $\frac{3}{16}$ | ⅛ | ⅛ | $\frac{3}{16}$ | $\frac{3}{16}$ | ¼ | $\frac{3}{16}$ | ⅛ | $\frac{3}{16}$ | ½ | ⅛ | $\frac{3}{16}$ | $\frac{3}{16}$ |
| Feed | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{3}{16}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ |
| Speed | 16 | 16 | 17 | 15 | 14 | 12 | 13 | 18 | 12 | 14 | 15 | 15 | 13 | 10 | 14 | 12 | 15 |

| Pair No. | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Putting in lathe | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 min. 28 sec. |
| Roughing | 10 | 8 | 9 | 9 | 11 | 9 | 11 | 9 | 10 | 7 | 10 | 9 | 10 | 10 | 7 | 10 | 9 min. 23 sec. |
| Finishing | 6 | 7 | 5 | 5 | 6 | 5 | 6 | 5 | 6 | 5 | 6 | 5 | 4 | 3 | 5 | 5 | 5 min. 7 sec. |
| Taking out | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 min. 0 sec. |
| Time from floor to floor | 20 | 18 | 17 | 18 | 21 | 17 | 21 | 17 | 19 | 16 | 20 | 18 | 18 | 17 | 14 | 17 | 17 min. 58 sec. |
| Depth of cut | ⅛ | ¼ | ¼ | $\frac{3}{16}$ | $\frac{3}{16}$ | ¼ | $\frac{3}{16}$ | ⅛ | ⅛ | $\frac{3}{16}$ | ¼ | $\frac{3}{16}$ | $\frac{3}{16}$ | ⅛ | $\frac{3}{16}$ | ¼ | $\frac{3}{16}$ inch |
| Feed | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ | $\frac{13}{32}$ inch |
| Speed | 11 | 12 | 10 | 14 | 12 | 14 | 13 | 11 | 14 | 20 | 15 | 17 | 17 | 16 | 21 | 18 | 14.4 feet |

WHAT A POND 42-INCH CAR WHEEL LATHE DID IN ONE DAY.

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FIRING UP LOCOMOTIVES.—In computing the expense of firing up locomotives the steam used for blower purposes should be taken into account, and it has been demonstrated that less blowing is required with oil and shavings than with wood or with the oil atomizer, this due to the coal igniting uniformly over the grates. A number of tests have been made demonstrating that the volume of coal required to build a fire from wood is equal to that where oil and shavings are made use of, it being evident that the heat units obtained from the combustion of the wood are practically lost, this due to the fact that large volumes of cold air pass through the grates as the result of uneven ignition. It is the opinion of the committee that except in the case of very light lines operating in the territory where wood is plentiful and where the number of locomotives handled is not sufficient to justify the installation for the use of oil and shavings, the use of wood should be abandoned.—*From committee report International Ry. Fuel Ass'n.*

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HANDLING SCRAP.—I wish to call your attention to the importance of handling scrap and the care which should be taken of it to give the best results from a financial standpoint, for the revenue on this alone amounts to thousands and thousands of dollars and goes a long way towards defraying the expenses generally. You will invariably see that the trunk lines, with the assistance of officials and subordinates who take a great interest in the scrap bins, very seldom go into the hands of receivers. The sorting of scrap is the most important, for the price per ton on all grades varies from 25 cents to $5.00. When the general storekeeper turns cars over to the transportation department for weighing, collection and sight drafts he should have a record of the car. In fact all scrap contracts should be handled through the store department and all collections made by it with the approval of the purchasing agent. That is, it should be taken out of the hands of the freight department entirely, except for billing, to get the best results.—*George Westall before the General Storekeepers' Assn.*

## VANADIUM CAST IRON FOR LOCOMOTIVE CYLINDER.*

Cast iron may be regarded as a more or less impure steel, containing, in addition to the usual elements present in steel, a comparatively large quantity of carbon in the form of graphite interspersed throughout its structure in the form of granules, flecks or plates. The graphite destroys the continuity of the metal. In consequence the limit of strength of cast iron is low as compared with steel, and it also follows that any improvement conferred upon cast iron by an alloy must necessarily not be as great as in the case of more homogeneous steel. In cast iron, also, we have a metal that is subjected to no work or heat treatment to develop latent qualities.

Nevertheless the benefits which accrue from the incorporation of small percentages of vanadium with cast iron, especially in chill and cylinder castings, are very great, even if they are not so spectacular in their nature as those obtained in steel. Vanadium not only cleanses the cast iron from oxides and nitrides, but also exercises a very strong fining effect on the grain of the iron, with the result that porosity is eliminated and sound castings are produced. Strength, resistance to wear and rigidity are all increased by the addition of vanadium to gray cast iron, while the vanadium martensites are much tougher than ordinary martensites. In the case of chilled cast iron, vanadium produces a deeper, stronger chill, and one less liable to spall or flake. Chilled iron rolls containing vanadium have shown remarkably increased resistance to wear in service.

As a result of two years' test on a pair of cast iron cylinders made of vanadium cast iron, the New York Central Railroad Company specified vanadium cast iron for the cylinders of 183 new locomotives built during the past eight months. The pair of cylinders under test gave upward of 200,000 miles, with only microscopical wear, whereas ordinary locomotive cylinders will show about 1-32 in. wear per 100,000 miles. These locomotives were built by the American Locomotive Company and comparative tests have been made between the iron containing vanadium and that to which no vanadium was added. The averages of 10 consecutive comparative tests are as follows:

| | Transverse strength. Pounds. | Tensile strength. Pounds. |
|---|---|---|
| Plain cast iron | 2,130 | 24,225 |
| Vanadium cast iron | 2,318 | 28,728 |

The transverse tests were made on 1-in. square bars, 12 in. between supports; the bars were machined all over and consequently were absolutely comparable, as is not the case with bars tested as they are cast. The tensile tests were also of machined bars. In machining the vanadium cast iron cylinders, the effect of the vanadium was noticed in the machining qualities of the iron; the chips were not so short, were tougher and showed considerable springiness.

The use of vanadium in cast iron will doubtless find its greatest field in engine cylinders, both gas and steam, where it will be of great value in increasing the life of the cylinder through its effect on the wearing qualities of the iron.

Tests of vanadium in malleable cast iron have been reported as satisfactory in every way, the fibre of the iron showing much cleaner and the tensile strength being improved about 12 per cent. The castings were also very much stiffer than ordinary malleable castings.

In applying vanadium to cast iron, it must be remembered that nothing like the heat of molten steel is at hand; consequently one should use a finely crushed or powdered alloy of a low melting point. As the melting point depends directly upon the percentage of vanadium contained in the alloy, a ferrovanadium containing under 35 per cent. vanadium should be used. If the iron to be vanadized is melted in the air furnace, the procedure is a very simple one: after the charge is melted and 15 to 20 minutes before tapping, the ferrovanadium is added and the bath well stirred or rabbled.

Where the iron is melted in the cupola it is necessary to add the vanadium to the ladle, and, as the amount of heat available for dissolving the ferrovanadium is limited,, the iron should be tapped out as hot as possible and a ladle used that has just been emptied in order to conserve as much heat as is practicable. After the bottom of the ladle is covered with a few inches of iron, the finely crushed or powdered ferrovanadium is added by sprinkling it on the stream of iron as it flows down the spout to the ladle. In this way advantage is taken of all the available heat, and there is also the mixing effect of the stream as it strikes the iron in the ladle. After the vanadium is added the contents of the ladle should be well rabbled and allowed to stand a few moments before pouring in order to insure thorough incorporation and complete reaction.

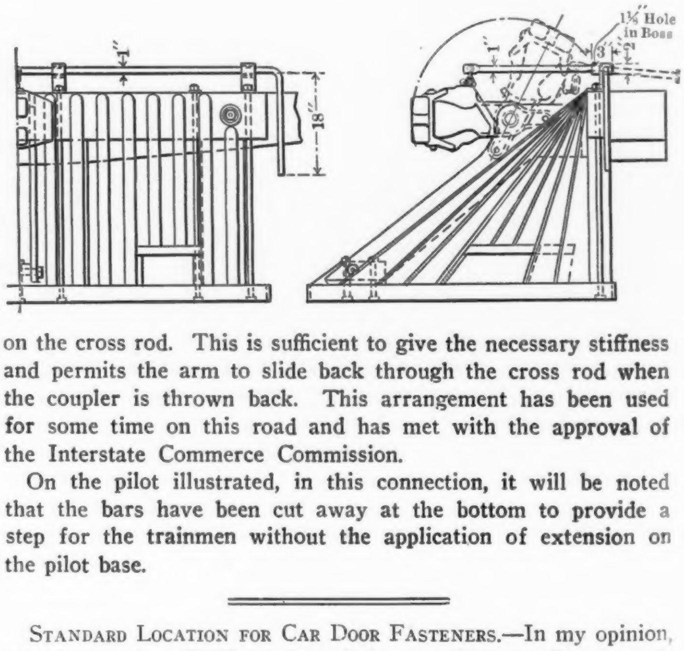
In the case of cupola iron, with its limited available heat, it has been found that the addition of 0.10 to 0.12 per cent. vanadium is all that should be attempted ordinarily; while in the case of high grade air furnace iron, with its reserve of available furnace heat, the addition of 0.18 per cent. to 0.20 per cent. is advisable and readily made.

The analyses of a great many tests show that about 70 to 80 per cent. of the vanadium alloys with the iron, the remainder being used up in cleansing the iron from oxides and nitrides. In remelting cast iron which has been vanadized, most of the vanadium is necessarily lost, owing to the very strong oxidizing conditions under which the iron is melted. The effect, however, of the small amount of vanadium remaining in the remelted iron is apparent in the texture of the grain and its consequent freedom from porosity.

* Extracts from a paper read at the May meeting of the New England Foundrymen's Association, at Hartford, Mass., by Geo. L. Norris.

## UNCOUPLING ROD ON THROW-BACK PILOT COUPLER.

Many roads desire to use the throw-back type of pilot coupler, but have been prevented from doing so because of the regulations for an uncoupling lever on these pilots. On the Atlantic Coast Line this difficulty has been solved by an arrangement that is shown in the accompanying illustration. The usual type of double ended cross arm is used, but instead of having the uncoupling arm forged integral with this rod, as is customary, it has been arranged to pass through a hole in a 3 in. boss forged




on the cross rod. This is sufficient to give the necessary stiffness and permits the arm to slide back through the cross rod when the coupler is thrown back. This arrangement has been used for some time on this road and has met with the approval of the Interstate Commerce Commission.

On the pilot illustrated, in this connection, it will be noted that the bars have been cut away at the bottom to provide a step for the trainmen without the application of extension on the pilot base.

STANDARD LOCATION FOR CAR DOOR FASTENERS.—In my opinion, the Master Car Builders' Association should prescribe a standard height from the top of rail for placing door fastenings on all new cars built and when repairing old cars requiring new doors, or door stops, the door fastenings should be placed at the new standard. If this is done it will only be a very few years until car door fastenings will practically all be of a standard, and seal records all over the country raised to a higher standard of accuracy.—*Mr. Levy, before the Association of Transportation and Car Accounting Officers.*

## NEW HORIZONTAL UNIVERSAL TOOL.

Machine shop people for some time have been in need of a tool at reasonable cost for machining the heavier class of very bulky castings which would be capable of performing a number of different operations with one setting of the work. With a view to meeting this demand especially for work on large locomotive castings requiring a large amount of time and labor for handling, such a machine has been designed and placed on the market by the Fosdick Machine Tool Co., of Cincinnati, Ohio.

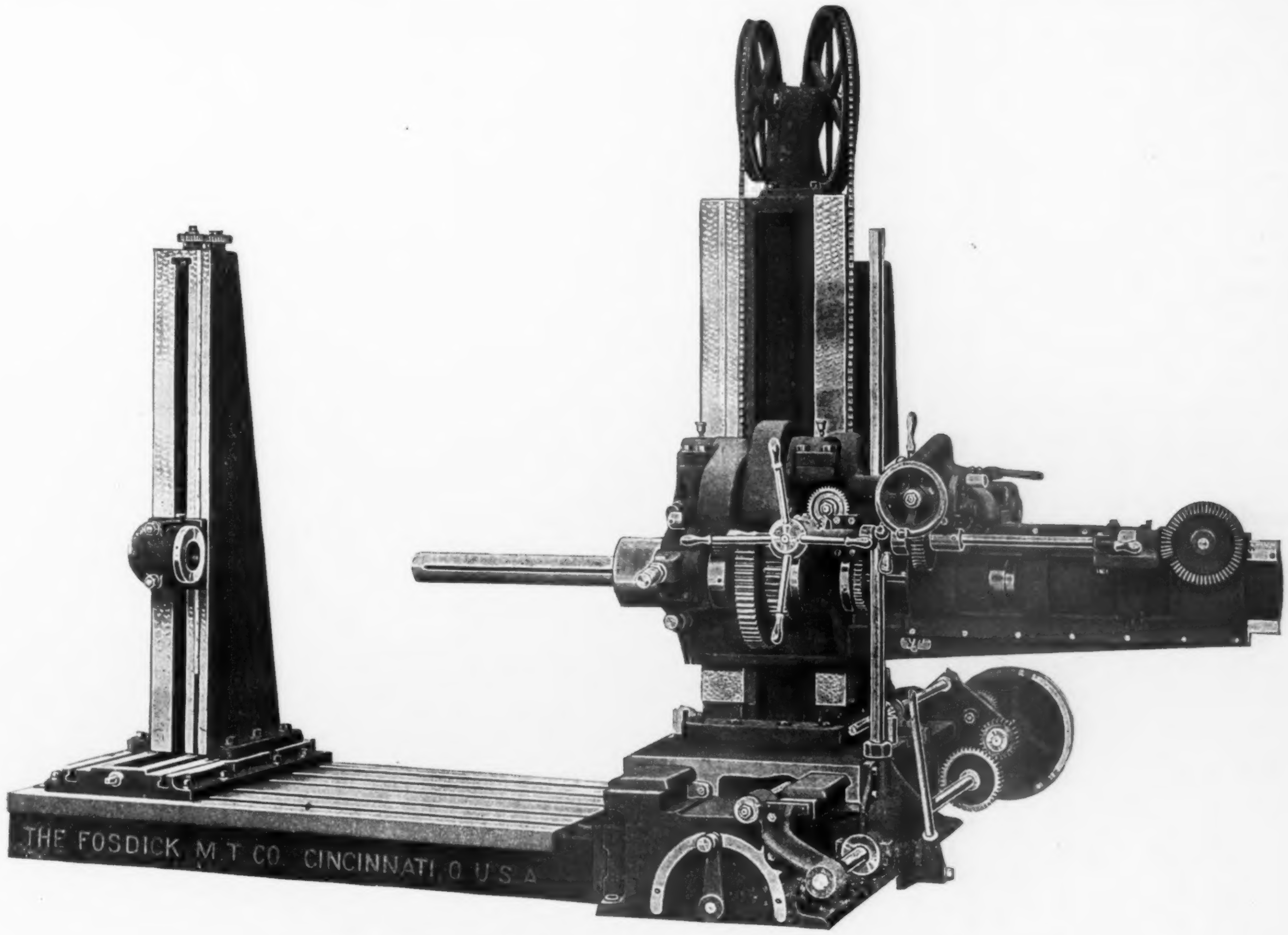
The accompanying illustration shows the new tool, known as No. 1, style D machine, combining the characteristics of a horizontal boring, drilling, milling and tapping machine. The bed plate and work table is very low so that the work of placing heavy castings is reduced to a minimum. The boring bar support at the left is designed specially for rigidity with broad square bearings at its base for the horizontal traverse, and also at its side for the bronze bushed tail bearing. Vertically, the traverse of the tail bearing on the bar support is simultaneous with that of the counterbalanced head on the column which is accomplished either by hand or power, so that the boring bar is always in perfect alignment. This is an essential feature in a well designed machine even when the boring bar itself is made of large diameter to withstand heavy strains.

The machine was designed throughout for the use of very high speed tool steels. With this high speed work in view the spindles are forged from the best quality of steel with liberally large diameters. All the gears are cut from steel with a large pitch and the journals are bronze bushed. The back gears and feed gears, as well as all the operating levers are located on the head, making a convenient and compact arrangement.

The column has very large bearing surfaces at its base for longitudinal traverse, reducing the wear at this point as much as possible, and the defects due to lost motion often found in a boring machine are practically eliminated. The general design of the column provides ample strength and rigidity to insure accurate work.

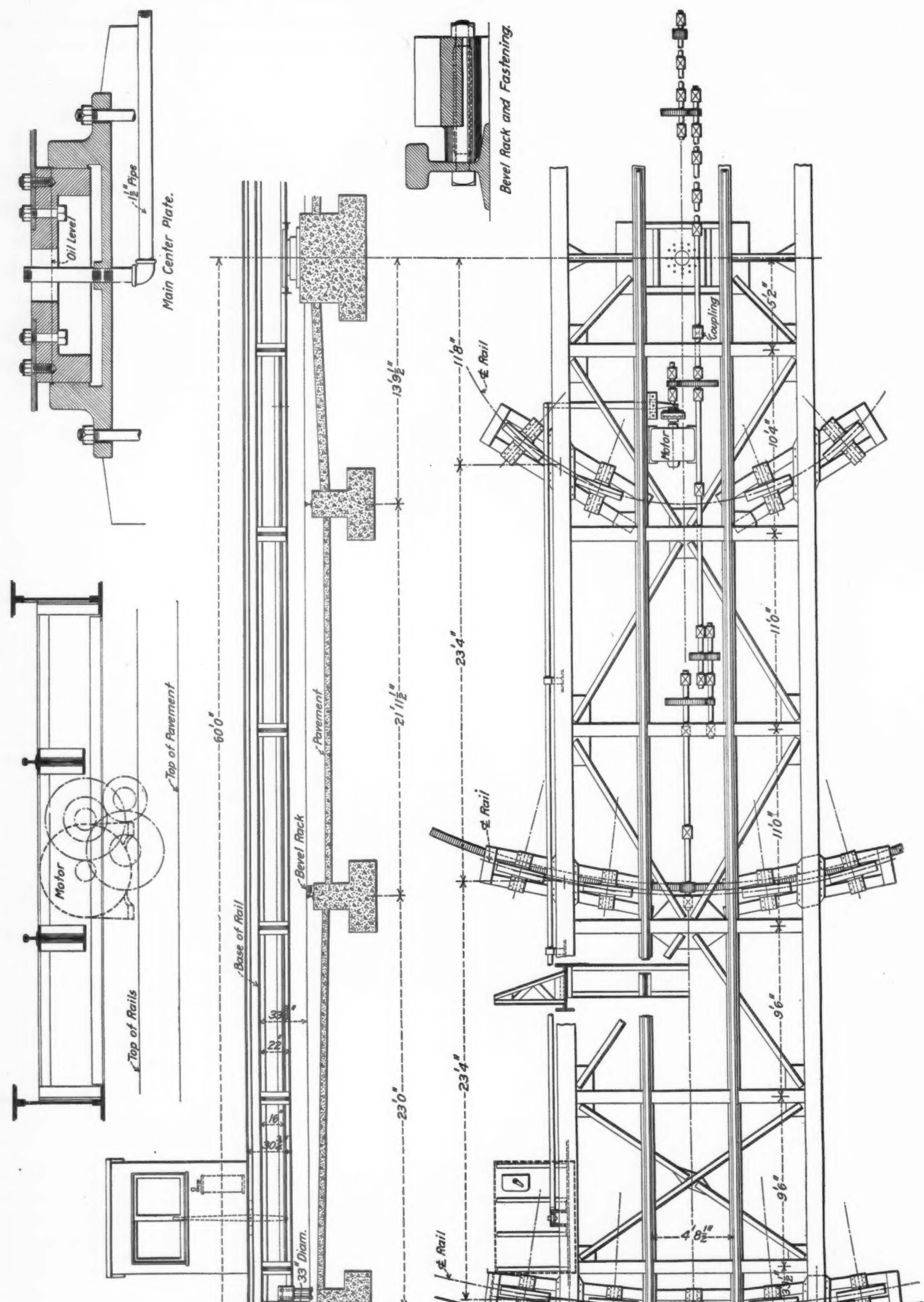
Power is transmitted either through a cone pulley or a speed box and may be supplied by a variable speed or constant speed motor mounted on the base if so desired.

These machines are built in two sizes, No. 1 and No. 2, and in four different styles. The style A machine is provided with a high work table and boring bar support. Style B is designed and generally used as a portable machine, there being no work table and boring bar support. Style C is the machine without a work table, but it is furnished with a special bar support usually mounted on the floor plate, and the style D machine is provided with a low work table, as illustrated. The latter tool is often furnished with a universal, rotating and tilting table by the use of which it is possible to drill, tap, bore or mill a large casting on five sides without resetting the work.




FOSDICK NEW HORIZONTAL BORING, DRILLING, MILLING AND TAPPING MACHINE.

P. R. R. PASSENGER CAR YARD AT PHILADELPHIA.—To eliminate congestion on its tracks between Broad Street Station and West Philadelphia, the Pennsylvania Railroad is enlarging its elevated railroad between these two points and building a passenger car storage yard east of the Schuylkill River. As the present car yard is a mile away from Broad Street Station, it has been found difficult to handle the shifting of trains necessary to haul some 21,000,000 people—the number arriving and departing in 1909 on 194,368 trains. The new car yard between 20th and 23rd streets will accommodate sixty cars, or about nine suburban trains, and will be equipped with a 70-foot turn-table, which will eliminate the sending of all locomotives to the West Philadelphia yard for turning. To complete the yard will necessitate the building of retaining walls and embankments, the extension of the arch bridges over 21st and 22nd streets, and the construction of two new bridges across the Schuylkill river. It is expected that the entire work will be completed by December 1st at a cost of approximately $750,000.




NEW TYPE OF TURNTABLE ESPECIALLY DESIGNED FOR THE HEAVIEST TYPES OF MALLET COMPOUND LOCOMOTIVES.

## NEW LOCOMOTIVE TURNTABLE.

The extensive introduction of Mallet compound locomotives into American railway service in the past few years has been the cause of much serious consideration of the facilities for housing and turning such locomotives at terminals. With this in view, a patent has recently been applied for by Frank H. Adams, engineer shop extension of the Santa Fe at Topeka, Kansas, covering an interesting and special design of motor driven turntable for this large class of power, thus solving one of the annoying problems of turning without disconnecting the tenders from the locomotives.

It is well known that railroads for years have turned their locomotives and rolling stock on turntables centrally supported and having end supports to temporarily take the load while the locomotive or car is being moved to a balanced position on the turntable, the latter being revolved either by hand through the means of extended levers at each end, or by means of a pneumatic or electric motor mounted on a platform hinged from the main turntable structure driving a wheel in frictional contact with a circular tee rail near the outer circumference on the bottom of the pit. The tractive force of this wheel due to the weight of the hinged platform, motor and mechanism was usually sufficient to revolve the turntable when the load was balanced and all in good working order. But the size and weight of railroad locomotives and rolling stock have been increasing rapidly during the past few years, until some locomotives with their tenders represent a combined weight in working order of about 350 tons and an extreme length over all of about 110 feet. It is desirable to turn these longer locomotives with their tenders without disconnecting the latter, and yet a length of 85 to 90 feet seems about the limit from an economical, practical, and operating standpoint for building the present type of centrally supported table and keeping within a reasonable expenditure.

It is therefore important that suitable means be provided for turning this heavier and longer power by providing a turntable longer and proportionately at a less cost than that of the present type tables and one provided with a simple and positive driving device. A new table which embodies in its design these features is shown in the illustration. The load instead of being almost entirely supported on the center bearing and foundation is more evenly distributed by providing three circular tracks and their foundations, located at approximately equal spaces between the center and outer edge of the pit. For this reason the foundation at the center is comparatively light and the usual massive center casting is eliminated. The small center plates shown in section are not intended to sustain any part of the load, their function being simply to aid in maintaining the table in a central position and to provide a place for introducing the electric wire conduit.

The usual style of built-up plate girders, braced transversely and diagonally, are used in the construction of the table and uniform support is provided by five 33 in. cast iron wheels at each end and four similar wheels on each of the two intermediate tracks. The electric motor is located in the first panel near the center plates and the shafting with two pairs of reduction gears is extended on each side of the center to a pinion at the circular rack which is fastened on the same foundation with the outer intermediate track as shown in the small sectional view. The pinion engaged by the rack is 11 in. in diameter by 5 in. wide and is intended to run at 45 r. p. m. There is an operator's cab supported in the usual manner near one end of the table.

Power is transmitted through a friction coupling near the motor, which is operated by means of a rod to the cab. To revolve the table the motor is started to allow full speed under no load before shifting the coupling into contact and thus transmitting the power to the rack pinions.

## BALATA BELTING PLANT.

In October, 1909 (page 416), this journal contained an article giving a complete description of Balata textile belting with facts concerning its manufacture, characteristics and application, and it is a well-known fact that a well made balata belt gives the best results where severe service is required. This belting is at present used extensively by many railroads as an axle generator belt for car lighting purposes, because it is thoroughly waterproof. It is also used largely for operating wood working machinery, for motor drives and on fine tooling machines.

Although an enormous quantity of Balata belting is in service in this country at the present time for transmission purposes, every foot of it has been manufactured in Germany or England and imported. The announcement, therefore, that a syndicate has been formed to introduce this new manufacturing interest into the United States will be of considerable interest, especially to present owners of the belting.

A corporation, to be known as the Victor-Balata and Textile Belting Co., has been formed combining American interests with those of the German firm of C. Vollrath and Son, which is the largest firm of textile belting manufacturers on the European continent. The New York Leather Belting Co., representing the American interests of the new enterprise, were pioneers in first introducing Balata belting in the American market.

The factory site, covering nine acres of ground, is located at Easton, Pa., and the buildings and equipment for the new plant will entail an expenditure of half a million dollars. An interesting feature in connection with the new plant is the complete small village to be erected on the site to house the large number of workmen and the large weaving plant for the cotton duck.

The officers of the new company are: Chas. E. Aaron, of New York, president; Edwin Vollrath, of Blankenburgh, Germany, secretary, and John R. Stein, New York, treasurer.

## STEAM AND ELECTRIC RAILWAYS.

Those who are doubtful of the future of electric railways or their relative progress should recall that the first steam railway in the United States was the Balitmore & Ohio on which construction was started in 1828 and which was opened to service in 1853. The first operating electric railway in this country was an experimental line at the laboratory of Thomas Edison at Menlo Park which was built in 1880. The first regular electric railway in the United States was one operated on Hampden Road, Baltimore, in 1886. The electric railways now carry more passengers annually than the steam railroads, with gross receipts amounting to less than one-sixth of those of the steam roads and with only an eighth of the mileage of the steam railroads.

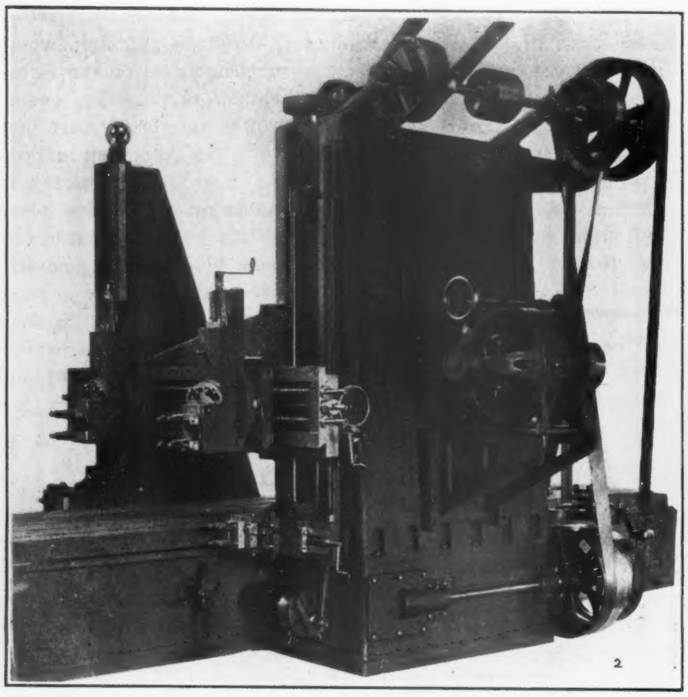
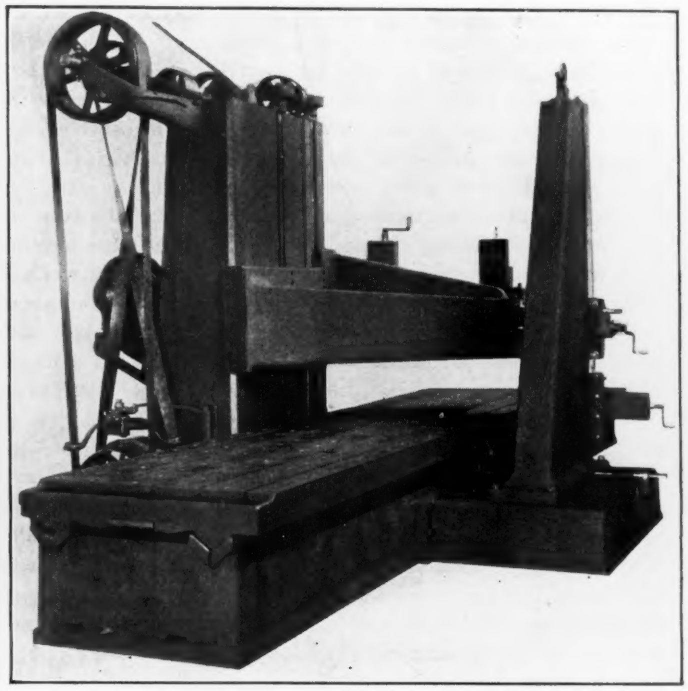
SELECTING MOTORS FOR MACHINE TOOL DRIVE.—One of the most important features in the selection of motors and one that is persistently overlooked, is the strict adherence to the use of standard motors, and by standard motors is meant standard armature shafts as well. The importance of maintaining standard armature shafts will be readily recognized by the factory management when it is pointed out that by such an arrangement spare armatures are reduced to a minimum, and that in an emergency it is possible, where these are not carried, to replace an armature or even a whole motor, from an idle tool, or from a tool of relatively less importance at the time. Also, of course, stock motors can be supplied promptly by the manufacturer and shipments materially improved if special shaft extensions are not called for. That special features in a motor are sometimes desirable, is not to be denied; it may so happen that the advantages from some special feature in the motor may more than offset the disadvantages above referred to, but in cases where these features are thought necessary they should be carefully considered before final decision.—*Chas. Fair before A. S. M. E. and A. I. E. E.*

## OPEN SIDE PLANER.

On some classes of work an open side planer is a necessity, on others it is a great convenience, and with the design illustrated herewith it is as valuable for nearly all kinds of work as the regular type.

This machine, as will be readily appreciated from the illustrations, is of exceptional rigidity and very conveniently arranged. It is designed so that four tool heads can be used and has all of the usual automatic feeds found on a four-headed planer. It is designed to take any cut which the tool will stand and is guaranteed for both accuracy and amount of cut to be equal to the same size machine of the usual type.

In construction the bed is cast closed on top and has solid cross ribs at frequent intervals, making it in fact a series of boxes. The column is cast solid with the bed up to the table level, at which point the upper section is securely bolted and doweled, resting on broad flanges. The table itself is of ample depth and is provided with T slots and holes at frequent intervals, none of the latter being bored through the table.

CLEVELAND OPEN SIDE PLANER, SHOWING ITS GREAT RIGIDITY AND STRENGTH.

Reference to the illustration showing the rear of the machine clearly indicates the exceptionally broad and stiff bearing which the cross rail has on the column. In this connection it might be mentioned that the outside column is employed entirely to give a fourth tool head and does not in any way support or stiffen the cross rail. This column can be quickly removed when the planer is to be used for open side work. The heads are arranged to be operated from either side of the machine and have automatic feeds in all directions.

All of the minor features throughout the whole machine have been given very careful study and many improvements here and there will be discovered. The belt shipping device is remarkably simple. All gears, except the bull gear and its pinion, are arranged to run in oil; the bearings are of phosphor bronze, pressed in so that they can be easily removed at any time without disturbing the alignment. It is further arranged so that all gearing and running parts can be removed through the sides of the machine, thus obviating taking down any heavy parts in case anything should need attention. The machine is arranged to be operated entirely above the floor level, making a special foundation unnecessary. It is suited for either electric or belt drive, the motor shown in the illustration being 25 h.p. variable speed.

The machine shown in the illustration is size 60 by 84 in. by 22 ft., and has an approximate weight of 94,000 lbs. This and other sizes of open side planers of the same general design are manufactured by the Cleveland Planer Works, 3148 Superior avenue, N. E., Cleveland, O.

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A YEAR'S CLEAN RECORD REWARDED ON THE LEHIGH VALLEY.—For several years the Lehigh Valley Railroad has punished minor infractions of its rules by what is known as "record suspension," which means that instead of a man being actually laid off for 30 or 60 days he continue at work, and this amount of punishment is entered against his record and stands the same as if he was out of service for that length of time. These records, of course, are taken into consideration when an employee is considered for promotion or is being disciplined for some other violation of rules. This system is found to be thoroughly satisfactory, and it has now been deemed advisable to further revise it. And beginning July 1, 1910, employees with imperfect records will have an opportunity to clear them by loyal and efficient service in the future. By this method employees having a clear record for two years prior to July 1 will be entitled to cancellation of all demerits previously incurred. A clear record for one year will cancel all demerits prior to 1905, and a clear record for twelve consecutive months at any time after July 1 will cancel demerit records up to that date. Ten days will be cancelled by a clear record of six months; 30 days by a clear record of 12 months, and 60 days by a clear record of 18 months after July 1. When an employee's demerit record aggregates 90 days he is relieved from duty and is also to be summarily dismissed for drunkenness, carelessness, insubordination, etc.

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EMPLOYEES GIVEN AUTOMOBILE TOURS.—Wells Brothers Company, of Greenfield, Mass., has been sending the foremen of the various departments of the factory and their families on outings during the summer months. These outings take the form of all-day automobile trips through the surrounding countryside and to the nearby cities and towns. One or two of the foremen, with their families, are sent at each time, the company providing a big touring car and paying all expenses. Each trip is about 125 miles long, the start being made early in the morning, and the return ride early in the evening. Dinner is arranged for at one of the hotels at the point of destination. These trips are all to different places and all have proved very enjoyable.

## COLD SAW CUTTING OFF MACHINE FOR BARS.

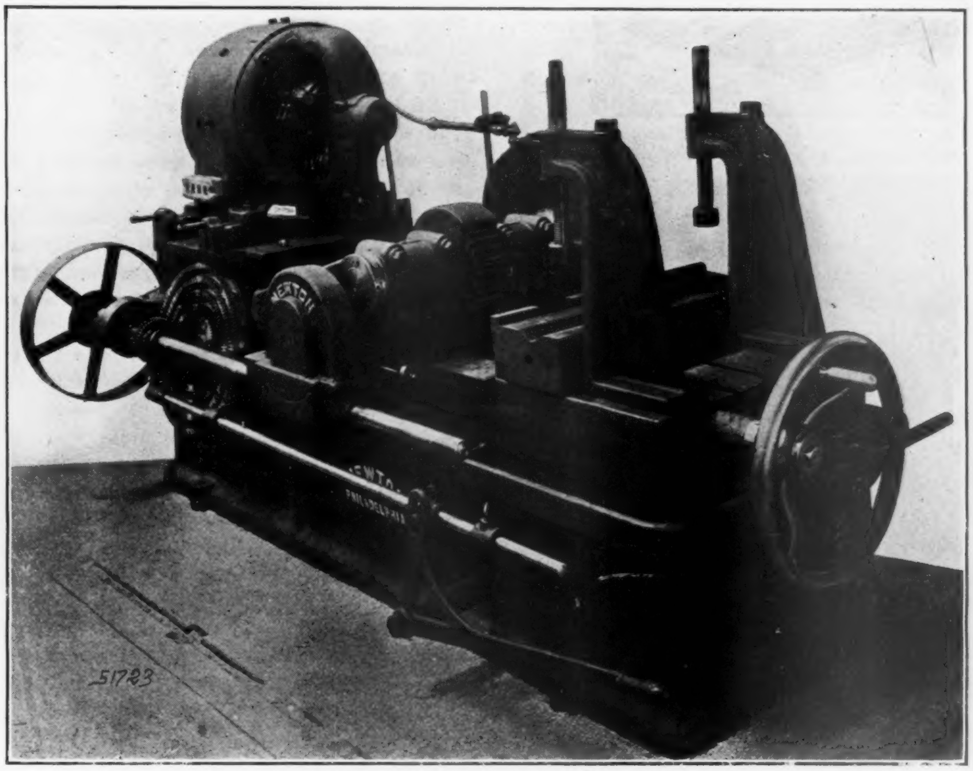
A new, cold saw, cutting off machine designed chiefly for rapid work in cutting heavy stock, is shown in the accompanying illustration. In addition to cutting off bars, slabs, shafting and I beams, this machine is also adapted to a variety of other work. It can be used to advantage in many cases to do some of the work that is usually done on slotters, planers or even milling machines with considerable saving of time. The saw is similar in general design to the one described in this journal November, 1909. It is, however, of more massive construction, greater rigidity and has some marked improvements in many of the details.

The capacity of the machine is 7½ in. round stock; 7 in. square stock; 15 in. I beams in a vertical position, on a square or miter cut, and 5 in. wide by 15 in. high for material with oblong section. Reference to the illustration will show the convenient arrangement of the operating levers and the simplicity in design and massive construction throughout, especially in the spindle, and its wide, capped bearings. An exceptionally broad faced, forged steel, spur driving gear is mounted in the middle of the shaft between the two main bearings. All the bearings where necessary are fitted with bronze bushings. Power is transmitted through the worm driving shaft and a steel spur gear cut from the solid shaft on which the worm wheel is mounted. The construction of the worm wheel and worm together with the roller thrust bearings, all of which are encased to permit them to run in an oil bath, is practically the same as that on the machine described in the issue referred to above. The same rigid and massive construction is provided in the spindle saddle with wide, square bearing surfaces on the frame of the machine and underlocking gibs, adjustments for wear being made by means of taper shoes.

A positive feed with four changes ranging from ¼ in. to 1½ in. per min. has been substituted for the continuous friction feed which was formerly used on the similar machines. This change is the result of special tests at the works of manufacturers in which it was found that the positive feed is much more efficient and better adapted to rapid work. This feed with its automatic, positive safety release arrangement, governed by a set of stops, tripped by adjustable dogs on the saddle, has been tested for the period of over a year and found very satisfactory.

Modern, inserted tooth saw blades are used, fitted with a hold-back to eliminate chattering when cutting material with thin sections, and structural steel which does not permit the engagement of two or more teeth of the saw at one time. The method of securing the saw blade to the end of the spindle has been greatly improved to be consistent with the general rigidity of the machine. This is accomplished by means of a circular plate fastened with one bolt at the center and secured further by six small flush pins arranged in a circle along its outer edge and extending through the saw blade. This arrangement not only saves time in removing and applying blades, as only one bolt must be removed instead of six, but it adds to the strength of the joint.

In the new lubricating system for the cutter blades the only change consists of including the oil storage tank in the base casting of the machine, thus eliminating the separate tank which has been in use. The system includes a small geared pump and attachments with piping extended to the point of cutting so that the lubricating and heat absorbing materials are delivered where they are the most effective.



NEWTON COLD SAW CUTTING OFF MACHINE.

This cutting off machine is manufactured by the Newton Machine Tool Works, Philadelphia, Pa. The worm driving shaft may be connected either to a motor, mounted on the end of the machine with a belt, gear or silent chain, or to a countershaft which is furnished when desired.

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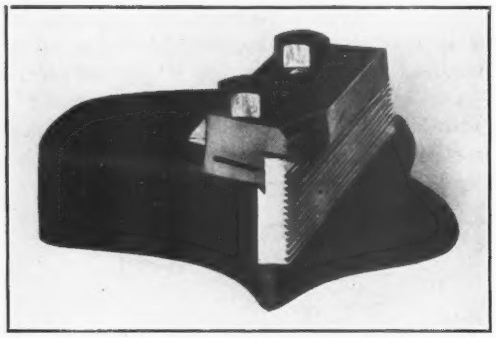
LATE TRAINS IN NEW YORK STATE.—During June there were 63,717 passenger trains operated over the steam railways in the State of New York. In the corresponding month, 1909, there were 55,551 trains and in 1908, 50,122. This year 88 per cent. of the trains were on time at division terminals. The average delay for each late train was 21.2 minutes. The causes of delay were as follows: Waiting for connections from other divisions, 28.3 per cent.; work at stations, 18.5 per cent.; waiting for connections with other railways, 11.5 per cent.; trains ahead, 7.6 per cent.; wrecks, 7.2 per cent.; engine failures, 6.9 per cent.; meeting and passing trains, 6.4 per cent.

## NEW DIE HEAD FOR PIPE THREADING.

For use on pipe threading machines using a stationary head, the Landis Machine Co., Waynesboro, Pa., has designed a new die head which can be mounted on the carriage of any of the standard pipe machines, and is arranged for manual operation in opening and closing the dies.

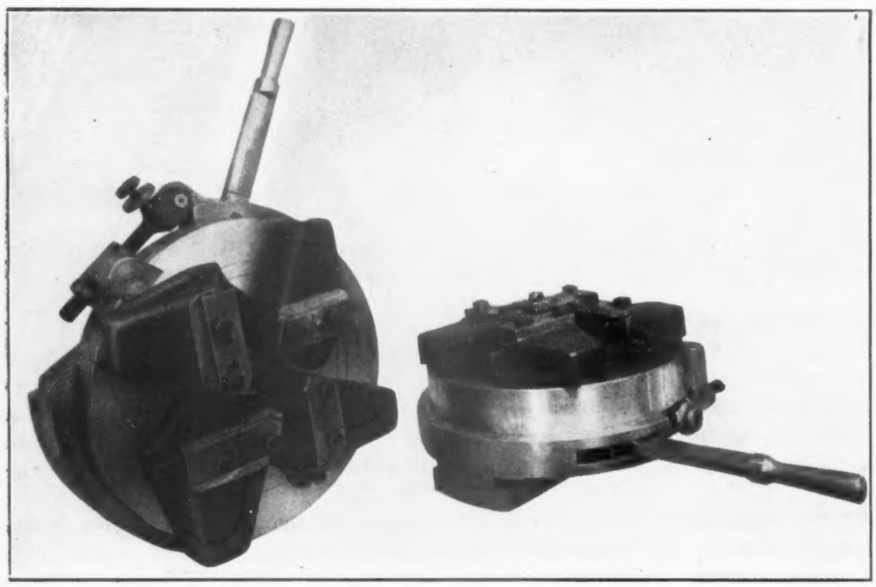
This head incorporates the use of the well-known Landis chasers which are made of high speed steel and only require grinding on the ends for sharpening. Their life is limited only



TYPE OF HOLDER USUALLY FURNISHED ON THE NEW LANDIS DIE HEAD.

by their length. After being ground at the angle giving the proper clearance for the material to be cut, they are quickly reset in the holders, the proper location being obtained by a small gauge furnished with the head.

Two types of holders can be obtained with this head, the ones shown in the illustration, which are not arranged for cutting close to a shoulder, being generally furnished. These holders, as in fact is the whole head, are made of steel. The clamp is so constructed that in addition to holding the chaser rigidly also



NEW LANDIS STATIONARY DIE HEAD.

protects it in case the pipe splits. It comes down over the throat of the die and is rounded out near the cutting point so as to act as a guide for rough ends, and at the same time when a twister occurs in the pipe the strain is thrown, in great part, on the clamp, thus protecting the die in such manner that the liability to breakage is small. When it is desired to thread close to a shoulder a clamp is used which comes flush with the front edge of the chaser only, thus permitting the die to run close up as in threading short nipples, etc.

This type of die admits of cutting speeds decidedly higher than the hobbed type, and since the clearance can at all times be ground to suit the quality of the material in the pipe, ideal cutting conditions are obtained.

The heads are graduated for setting the dies to the different diameters to be threaded. It is opened and closed by hand and when in the closed position the die is rigidly locked, but opens and closes freely by means of the lever. All dies are made to interchange perfectly, and if one chaser of a set should be worn out in advance of the others, this single chaser can be replaced without replacing the entire set.

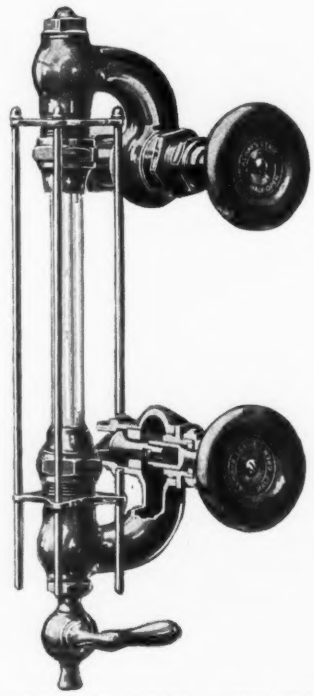
Dies of any one pitch will interchange on any of the die heads so long as the pitch is within the range of the head. For example, dies for threading 1 in. pipe on the 1 in. head will also thread 1 in. pipe on the 2 in. head, or vice versa, thus avoiding the necessity of carrying a large assortment of dies to cover the range of work when using a number of these heads. Of course, one set of dies will also cut all sizes having the same number of threads, as from 1 in. to 2 ins. for example.

## AN AUTOMATIC SAFETY WATER GAUGE.

The Swartwout Automatic Safety Water Gauge, manufactured by the Ohio Blower Co., eliminates, to a large degree, the dangers resulting from broken gauge glasses. Quick-closing automatic valves are arranged to cut off the flow of water and steam the instant the glass breaks.

In each of the two gauge bodies there is an automatic valve held away from its seat while in use by a spring, shown at F in the sectional view. In case of breakage this valve is closed quickly by the steam pressure in the boiler. The valve is also controlled by the hand wheel, so that both valve and valve seat are easily removed for cleaning without disturbing the gauge at the boiler connections and without removing the packing of the gauge glass.

As shown in the sectional view, the screw E holds the parts



AUTOMATIC SAFETY WATER GLASS.

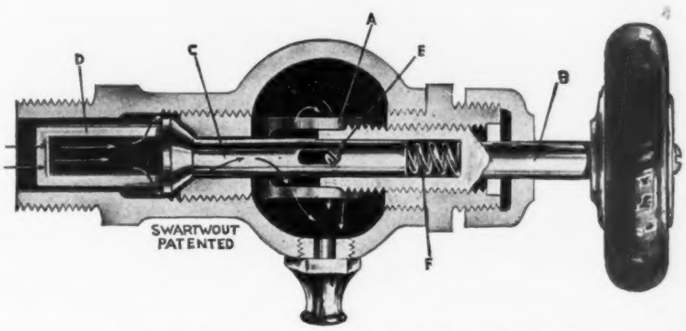
of the valve together, and when taken out with a small screw driver or penknife all the parts are released. At the inner end of the valve stem C a flat scraper D loosens any sediment adhering to the boiler connection and as it revolves with every turn of the hand wheel the opening is cleared frequently. The removable valve case A is provided with two external threads of the same pitch, but of different diameters, so that the threads on the inner end may slip by the outer internal thread when inserted. The threads are cut so that both sets engage the threads of the gauge body at the same time, thereby insuring a good fit.

On replacing a broken glass the hand wheel is turned forward until the valve is forced from its seat, thus allowing water or steam to flow from the boiler into the gauge glass; the valve on

the other gauge body will then automatically open to equalize the pressure. In turning the hand wheel forward to force the valve from its seat, the movement of the spring F in stem B must first be taken up before the valve moves. Every turn of the wheel turns the valves upon their seats. In this way they regrind themselves automatically.

When the valve case is removed there is an unobstructed opening into the boiler 1 inch in diameter, obtained without in any way disturbing the gauge bodies.

Another ingenious feature of the Swartwout Gauge Glass is the gooseneck gauge body. This form of construction allows a

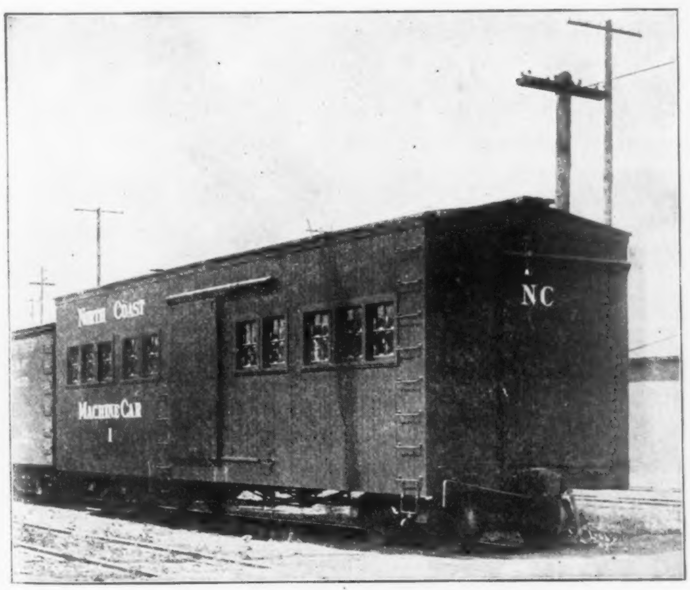



DETAIL OF SWARTWOUT SAFETY WATER GAUGE.

gauge glass 2 to 4 inches longer than usual, thus giving greater visible range of water level. Offsetting the gauge glass renders the operation of replacing a broken gauge glass an easy task. It is inserted through either the top or bottom of the gauge without in any way disturbing the valves or seats. It need not be of any particular length, an inch or more making no difference. It permits the use of softer packings, which with the flexible construction relieves the strain on the gauge glass, thereby greatly reducing breakages. In cleaning also the value of the gooseneck is apparent, for by simply removing the top plug or the drain cock at the bottom, the swab for cleaning is easily inserted, without in any way disturbing the valves or gauge bodies.

## SELF PROPELLED MACHINE SHOP.

The North Coast Railroad is a new line being built through central and western Washington from Spokane to the Cascades. During the construction there are, of course, a large number




MACHINE SHOP ON WHEELS.

of locomotives and cars in regular service which are continually getting further and further away from the base and in order to properly maintain this equipment a traveling machine shop has been designed.

This shop consists of a specially constructed, very large box car with numerous windows on each side, which encloses the gas engine for driving the tools and a selection of tools suited for the work to be done. The gas engine is a 12 h.p. Fairbanks-Morse and is connected through a friction clutch to the wheels, so that the car is capable of going from place to place under its own power and can also do switching to get into the most convenient location. It is capable of a speed of about 10 miles per hour. In the car are conveniently located the following tools driven by belts from line shafting running along each side of the roof: 23-inch engine lathe; 16-inch shaper; 1½-inch bolt cutter; 22-inch vertical drill; 6-in. pipe threading machine and emery wheel. The car is 39 ft. 10 in. long, 9 ft. 6 in. wide and 9 ft. high inside.

## STEAM AND AIR FLOW METERS.

It is often desirable to know and obtain a constant record of the amount of steam or air flowing through pipes which furnish a supply to either separate pieces of machinery or to a whole plant. The Pitot tube has been used for this purpose with a fair degree of accuracy when making an efficiency test of a plant or some piece of apparatus, but in those cases it is necessary to make frequent observations and records, and up to recently there

INTERIOR OF MACHINE SHOP CAR.

has been no instrument which could do this automatically and present the results as a graphical record.

Realizing the demand for an instrument of this kind, the General Electric Co. has recently perfected a meter which furnishes a record on a roll of paper similar to the record from a Boyer speed indicator. These instruments have been very carefully tested and checked and have been found to be very accurate. They can be installed on any pipe line with little difficulty and no rearrangement of the connections and are arranged so as to register accurately for either a constant flow or an intermittent flow, as desired.

A modification of the Pitot tube principle is used in this instrument, which in brief consists of placing a U tube carrying mercury, on a balance, so arranged that a change in the level in the two legs of the tube tends to destroy the balance of the beam, which tendency is recorded by a pen point on a roll of paper through the medium of a series of counterbalanced levers.

A brass nozzle and plug, shown in Fig. 1, is inserted in the piping at the place where the flow is to be measured. This nozzle carries two sets of openings, one facing the direction of the flow and extending diametrically across the nozzle and the other a trailing set consisting of two openings, one at 90 degs. and the other at 180 degs. in the direction of the flow. The impingement of the steam against the leading openings sets up in them a pressure equal to the static pressure plus that due to the velocity head, while the trailing set is affected by the static pressure less that due to the velocity. The difference in these values is a

measure of the velocity and for constant temperature and pressure gives the rate of flow. The pressures in the two sets of openings are connected through separate longitudinal tubes to the plug, and from there by ¼-in. pipes to the meter.

Figure 2 shows the whole apparatus as connected with pipe

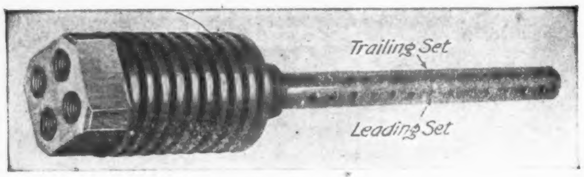



FIG. 1.

and Fig. 3 the details of the recording meter. In this are two cylindrical hollow cups filled to about one-half their height with mercury and joined at the bottom by a hollow tube. This U tube is supported on and free to move as a balance about a set of knife edges. The two pressures from the plug are connected to the cups by flexible steel tubing, which offers a minimum resistance to the movement of the balance. The greater pressure acting upon the left hand cup, for instance, forces more mercury into the right hand cup and thus tilts the beam about the knife edges until the movement of the counterweights at the extreme right of the meter exactly balances the displacement of the mercury. This movement is multiplied by levers and registered by the pen upon the roll of paper, which is driven by an eight-day clock at a rate of about 1 inch per hour, this roll being properly ruled to show the flow in lbs. per hour.

Proper correction weights and adjustments are provided to adapt the instrument to any degree of pressure or temperature. In cases where the pressure varies more than 10 lbs. from the

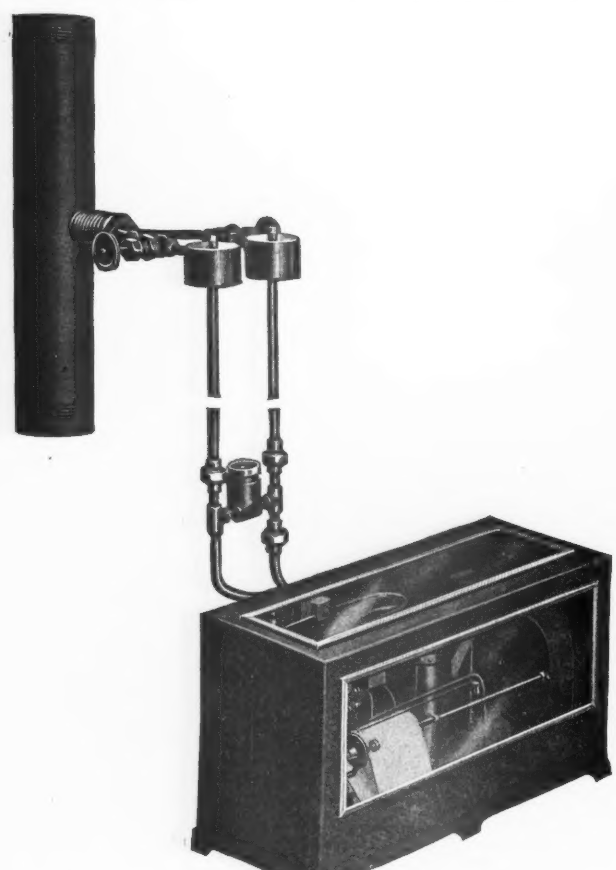


FIG. 2.

normal, an automatic correction device is included to compensate for the error thus introduced on the instrument set for a constant pressure. This consists of a hollow spring similar to the pressure spring in the steam gauge and is connected so as to be influenced by the static pressure of the steam at a point

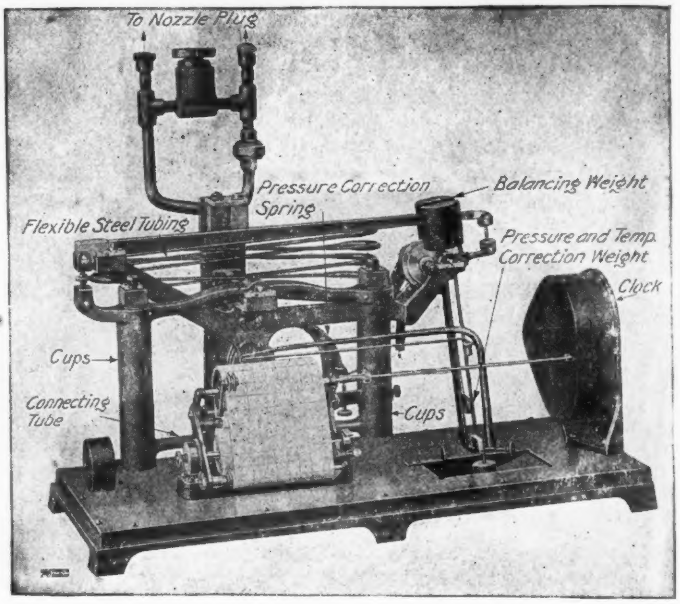



FIG. 3.

where the flow is being measured. The movement of this spring actuates a small correction counterweight and permits an accurate record being obtained for any rate of flow under varying pressure.

An instrument which will indicate, but not graphically record, the rate of flow of steam or air is shown in Fig. 4. This instrument is arranged on the principle of a float on the surface of the mercury in a U shape tube, which actuates a pulley that in turn moves a small U magnet. This magnet affects an indicating needle mounted in a separate cylindrical casing and registers on a calibrated dial, as shown in the illustration.

These instruments, since their introduction a short time ago,

FIG. 4.

have proven to be of great value not only for test work, but for keeping a close watch on the daily operation of various machines and the immediate determination of any unusual condition that might lower the efficiency. The General Electric Co., Schenectady, N. Y., is issuing a very fully illustrated catalogue that gives the sizes suited to different conditions.

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TRAFFIC THROUGH THE SOO CANALS.—There were a total of 3,242 vessels passing through the U. S. and Canadian canals at Sault Ste. Marie in July, 1910. These vessels carried a total of nearly ten million tons of freight. Of this seven and a half million was east bound and two and a half million west bound.

## MEN WANTED.

PUBLICITY MANAGER.—Man capable of handling the preparation of catalogs and bulletins and special literature for a railway supply company. Address A. H. A.

CAR DRAFTSMAN.—Experienced man on car design, especially passenger cars, on prominent eastern railroad; excellent opening for the right man. Address W. R. M.

LOCOMOTIVE DRAFTSMAN.—Two or three men experienced in locomotive design and construction wanted by large road in the southwest; salary $80 to $100. Address H. H. M.

## POSITIONS WANTED.

MECHANICAL ENGINEER OR CHIEF DRAFTSMAN.—Long experience in the drafting room of railways; at present chief draftsman; wishes position on a southern railway. Address P. F. R.

CHIEF DRAFTSMAN OR SIMILAR POSITION.—Technical man, seven years' railroad experience; now leading draftsman on locomotive and electrical work on one of the largest railway systems. Address E. J. W.

EXPERT ON MACHINE TOOL DESIGN.—Has had long experience with the design and building of machine tools and dealing with the problems of shop production. Well equipped for duties as director of a trade school or similar work. Address S. C. J.

DESIGNER OF RAILROAD SPECIALTIES.—Man thoroughly experienced in railroad design now chief draftsman of one of the largest systems wishes position with a supply company handling railway specialties, that require a designer of exceptional ability. Address R. L. W.

GENERAL INSPECTOR.—Middle-aged man with technical education; 20 years' experience; expert on fuel, tests, spark throwing and front end arrangements; has held all positions from fireman to master mechanic and from machinist to mechanical engineer. Address S. S.

MECHANICAL ENGINEER OR SALES ENGINEER.—University graduate; twelve years' practical experience as designing engineer and estimator with locomotive car manufacturers; has been chief draftsman on a large western railroad and is a specialist on steel coach calculations, designs, estimates and details. Address H. D. W.

SALES ENGINEER, INSPECTOR OR MECHANICAL ENGINEER.—Graduate in mechanical engineering, with nine years' practical experience in capacity of special apprentice, draftsman, chief draftsman, roundhouse foreman, mechanical inspector and chief estimator with railroads and steel car manufacturing concern. Thoroughly experienced in mechanical lines and exercising of executive ability. Address S. F. W.

## PERSONALS.

W. R. WOOD has been appointed engineer of tests on the Great Northern Ry., with office at St. Paul, Minn.

CHARLES F. ROBERTS has been appointed assistant locomotive superintendent of the United Railways of Havana, with office at Havana, Cuba.

H. L. JACE has been appointed master mechanic of the South Dakota Central Ry., with offices at Sioux Falls, S. D., succeeding C. A. Swan, resigned.

WM. HILL has been appointed master mechanic of the Iowa Central Ry. at Marshalltown, Ia., succeeding C. E. Gossett.

M. FLANNAGAN has been appointed master mechanic of the Richmond division of the Chesapeake & Ohio Ry., with headquarters at Richmond, Va.

D. P. KELLOGG, master mechanic of the Southern Pacific Co. at Los Angeles, Cal., has been appointed shop superintendent of the Los Angeles general shops.

W. V. O'NEILL has been appointed master mechanic of the Crystal City and Uvalde Railroad, with office at Crystal City, Texas, succeeding J. S. Hardwick.

C. J. ANDERSON, formerly master mechanic of the National Lines of Mexico, has been appointed assistant superintendent of the Southern Pacific Co. at Nazatlan, Mexico.

F. A. BUTLER has been made master mechanic of Boston division of the Boston and Albany R. R., with office at Beacon Park, Allston, Mass., succeeding J. B. Canfield, transferred.

E. J. SEARLES has been appointed assistant to the general superintendent of motive power of the Baltimore & Ohio R. R. Co. and Baltimore & Ohio Southwestern R. R., at Baltimore, Md.

T. H. HAGGERTY has been appointed smoke inspector on the Chicago terminal division of the Chicago, Rock Island & Pacific Ry., with office at Chicago, succeeding E. A. Lutzow, resigned.

THOMAS O'LEARY, master mechanic on the Tucson division of the Southern Pacific Co., at Tucson, Ariz., has been appointed master mechanic at Los Angeles, Cal., succeeding D. P. Kellogg.

L. L. WOOD has been appointed acting superintendent of motive power and machinery of the Evansville & Terre Haute R. R., with office at Evansville, Ind., succeeding G. H. Bussing, resigned.

W. C. PETERSON, round house foreman of the Southern Pacific Co. at Yuma, Ariz., has been appointed master mechanic on the Tucson division at Tucson, Ariz., succeeding Tom O'Leary, transferred.

C. H. HOGAN, division superintendent of motive power of the New York Central & Hudson River R. R. at Depew, N. Y., has been appointed assistant superintendent of motive power, with office at Albany, N. Y.

J. B. CANFIELD, master mechanic of the Boston division of the Boston & Albany R. R., has been appointed master mechanic of the Albany division, with office at West Springfield, Mass., succeeding A. J. Fries, promoted.

W. B. LILLIS, general foreman, Illinois Central R. R. shops, Waterloo, Iowa, and formerly holding similar positions at Burnside and Freeport, Ill., has resigned, to become superintendent of Greenlee Brothers Company, Rockford, Ill.

GEORGE H. BUSSING, superintendent of motive power of the Evansville & Terre Haute R. R., at Evansville, Ind., has been appointed superintendent of motive power of the Buffalo & Susquehanna R. R. and the Buffalo & Susquehanna Ry., with office at Galeton, Pa.

A. J. FRIES, division master mechanic of the Boston & Albany R. R., at Springfield, Mass., has been appointed division superintendent of motive power of the Western division of the New York Central & Hudson River R. R., with office at Depew, N. Y., succeeding C. H. Hogan, promoted.

C. E. GOSSETT, master mechanic of the Iowa Central Ry., at Marshalltown, Iowa, has been appointed master mechanic of the Minneapolis & St. Louis Ry., with office at Minneapolis, Minn., succeeding J. Hill, resigned.

## CATALOGS.

CHAMBERS THROTTLE VALVE.—The Watson, Stillman Co., 50 Church St., New York, is issuing Catalogue No. 80, which very fully illustrates and describes the Chambers throttle valve, that is made the subject of a descriptive article in another part of this issue.

ADAPTER BEARINGS.—A leaflet being issued by the Hess-Bright Mfg. Co., Philadelphia, Pa., shows how ball bearings can be adapted to any point on a shaft, where a hanger can be located, without difficulty. A bushing is applied to the shaft and secured by taper pins and on this the ball races are mounted in a very simple manner.

FIRE EXTINGUISHER.—"Success" fire extinguishers in hand operated sizes as well as larger ones mounted on a truck are the subject of a leaflet being issued by the H. W. Johns-Manville Co., 100 William St., New York. These extinguishers are most substantially constructed and are intended to be thoroughly durable as well as thoroughly efficient.

THROTTLE STEM PACKING.—A leaflet being sent out by the Plunger Plastic Packing Co., St. Paul, Minn., illustrates an entirely new design of stuffing box for throttle stems, which it is claimed is absolutely leak proof and can be applied with a full head of steam in the boiler. This packing is applicable to old as well as new construction and uses but one size packing for all size throttle rods.

ACETYLENE LIGHTING.—The safety, convenience and reliability of the acetone system of storage for acetylene gas is now very fully accepted and recognized by all railroad men, as well as automobile owners. The Commercial Acetylene Co., 80 Broadway, New York, which controls this type of apparatus for all railroad uses, are issuing two attractive catalogues or pamphlets, one being devoted to standard locomotive headlight equipment and the other to railway car lighting equipment. These catlogues briefly cover the essential features of both of these equipments and will be found to be of decided interest to motive power officers.

COAL AND ORE HANDLING MACHINERY.—A most attractive publication, consisting of an exceptionally well chosen series of photographs in sepia on a rough coated paper, is being issued by the Brown Hoisting Machinery Co., Cleveland, O. These photographs, to the number of 62, illustrate the most modern arrangement of machinery for handling any product that is capable of being conveyed with a clam shell bucket. They include some of the very largest coal and ore handling plants in the world and in many respects this exhibition, in the shape of photographs, is far more impressive than any statement of sizes and capacity could possibly be.

CAR HEATING.—Complete half-tone illustrations, sectional and perspective line drawings and table showing names of different parts, together with descriptive matter of the different systems, make up a large part of the 165 page catalogue, each sheet measuring 9 x 12, being issued by the Gold Car Heating and Lighting Company, Whitehall Building, New York. The Gold systems include those for steam, vapor, hot water and electric heating, acetylene lighting and systems for ventilation of railway cars. It would be impossible in a brief space to begin to indicate the scope of this book, and it is only possible to say that it is complete and contains a very complete index for quick reference.

ELECTRIC HEADLIGHT SYSTEM.—The complete apparatus for generating and using electric current for head and cab lights on steam locomotives is the subject of Bulletin No. 101 from the R. G. Peters Mfg. Co., Grand Rapids, Mich. This system includes an efficient steam turbine direct connected to an electric generator mounted in a compact manner. The generating apparatus is most fully described and illustrated in the catalogue, each particular detail being considered separately. The same is true of the arc lamp for the head light, which can be furnished with either copper and carbon terminals, or with two carbon terminals, either vertically or horizontally arranged. Also included are the results of tests made at the University of Illinois, which shows the steam consumption, candlepower, etc., of the apparatus.

BRAKE BEAMS.—Ninety pages, 6 by 9 in. size, each containing a full dimensioned and detailed line drawing of a brake beam or bolster, is being issued by the Chicago Railway Equipment Co., McCormick Building, Chicago, Ill. In addition there are included some reproductions from photographs of the various beams and also illustrations of roller side bearings, adjustable brake heads, slack adjusters and journal boxes. This method of showing its product by dimensioned drawings most carefully made and large sized reproduction of photographs unaccompanied by any comment or descriptive matter, will be appreciated by railroad men who often have need of exactly the information here given and find it unavailable in most catalogues. The book is of the loose leaf variety and will be extended as new designs are brought out.

CUTTER HEADS FOR WOOD WORK.—Catalogue No. 30, from Samuel J. Shimer & Sons, Milton, Pa., contains 224 pages given up to illustrations accompanied by brief descriptions, details of sizes, and prices of the exceptionally large variety of cutter heads manufactured by them. Many pages in the catalogue carry illustrations of cross sections of lumber of various kinds, which are dimensioned and show exactly the character of work the various heads are arranged to do. Some of these mouldings and ceilings are unusually complicated in appearance, but the cutter heads are as simple for them as for ordinary tongue and grooving. This company also furnishes cylinders to order to fit any surfacing or planing machine; in fact, this catalogue clearly indicates that there is nothing in the shape of a cutter for wood work that cannot be obtained from this company.

PORTABLE ACETYLENE LIGHTS.—The value of a strong, efficient and simply operated portable light is thoroughly appreciated by railroad men in all departments. If the apparatus is properly designed, acetylene offers probably the most satisfactory source for a light of this character and the arrangements shown in the catalogue being sent out by the Alexander Milburn Company, 507 West Lombard St., Baltimore, Md., fully covers the field. These lights are furnished in any size, to be carrried as a hand lantern as well as stationary lamps, which are easily transported by one man, and also in larger sizes where the lamp, through the medium of a hose, can be placed in any satisfactory location, the generator being some distance away. These lamps are made in all sizes up to 5,000 candlepower. The catalogue includes complete tables of sizes and gives the price of each arrangement.

COUPLER, DRAFT GEARS AND STEEL CASTINGS.—A loose leaf catalogue with most susbtantial covers, printed on exceptionally highly finished paper, which brings out the details of the illustrations to the very best advantage, is being issued by the Gould Coupler Company, 341 Fifth Ave., New York. This catalogue contains 146 pages and is arranged to show in large size, retouched, half-tone illustrations, line drawings and concise descriptive matter the large assortment of car and locomotive parts manufactured in the various malleable iron and steel casting plants of this company. The first part of the book is given up to freight couplers of the Gould pattern, which has more than kept pace with the modern requirements. Following this are friction draft gears, in which section are included drawings showing the application of this gear to different types of cars. Next follow cast steel body and truck bolsters and cast steel end sills, followed by cast steeel truck frames. Hartman ball bearing centre and side bearings are then considered, this section including comparative tests carried out in some detail and deductions as to the saving in coal and water possible by the use of bearings of this kind. Phantom views of journal boxes clearly illustrate the internal arrangement and advantages of the Gould insert journal box lid. The next section of the catalogue covers the same parts and appliances as furnished for passenger cars and here are also given friction and spring buffers, standard vestibules, etc. The section on locomotive equipment includes couplers for tenders and pilots, buffers and journal boxes for tenders. The next section is on electric traction appliances and shows the Gould radial buffer and swing coupler. Steel locomotive and car axles are illustrated and briefly commented upon. Several pages at the end of the catalogue are given up to the apparatus of the Gould Storage Battery Co. for car lighting. This catalogue is furnished with the idea of furnishing a busy man with exactly the information he requires with the least expenditure of time. It is substantial and suited for hard usage, while at the same time being most attractive in every particular.

## NOTES.

GRIP NUT CO.—E. R. Hibbard, president, accompanied by his wife and son, left Chicago July 28 for a ten weeks' trip to the Orient.

T. H. SYMINGTON CO.—E. H. Symington has been appointed mechanical expert of the above company and will be located in the Chicago office of the company, 316 Railway Exchange.

RAILWAY STEEL SPRING CO.—It is with profound regret that we have to chronicle the death of William H. Silverthorn, president of the above company. Mr. Silverthorn was 61 years of age, and died at his home in Painesville, Ohio, on August 13.

C. W. HUNT CO.—Arrangements have been made by the above company, of New York, builders of coal handling, conveying and hoisting machinery, by which their business on the Pacific Coast will be handled by the San Francisco Bridge Company, with offices at 865 Monadnock Building, San Francisco, Cal. This company has just completed a coaling station in San Francisco for the government.

LOCOMOTIVE SUPERHEATER CO.—It is announced that the above company has acquired the United States and Canadian rights under the basic patents upon fire tube superheaters. There are in successful operation or in course of construction in Europe over 6,000 of these superheaters and in America more than 800 have already been installed. These patents include the inventions of Messrs. Wilhelm Schmidt, H. H. Vaughan, A. W. Horsey, Francis J. Cole and others. The principal office of the company is located in the Hudson Terminal Building, 30 Church Street, New York.

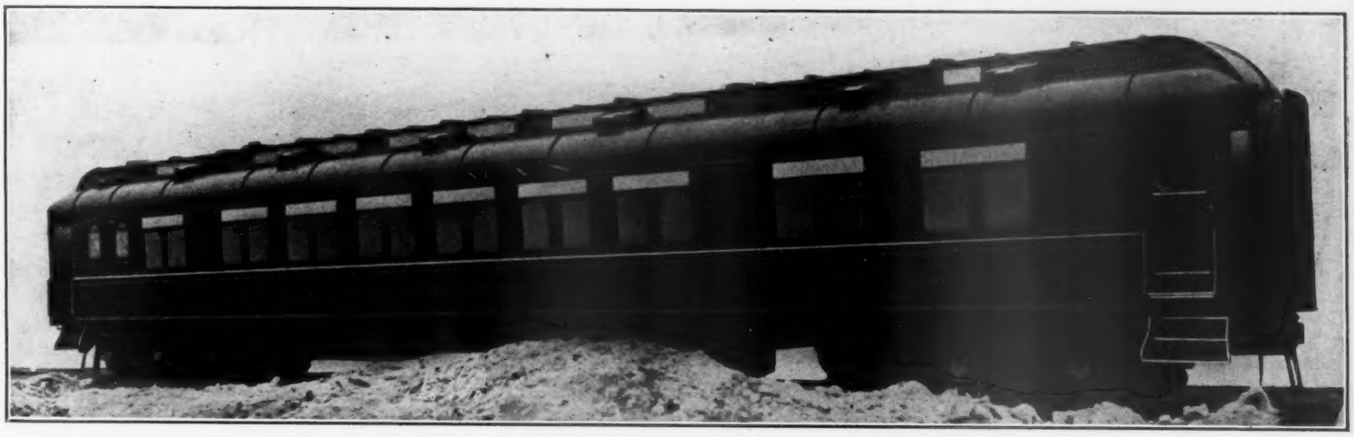
# All Steel Pullman Cars

THE PULLMAN COMPANY HAS PERFECTED A DESIGN FOR ALL STEEL SLEEPING, PARLOR, CLUB AND PRIVATE CARS, WHICH PERMITS THE USE OF A STANDARD UNDERFRAME COMPLETE AND MANY OTHER STANDARD PARTS FOR ALL CLASSES OF CARS. THE FOLLOWING DESCRIPTION APPLIES PRINCIPALLY TO THE SLEEPING CARS.

The Pullman Company now has in service on the Pennsylvania over 300 all-steel cars, representing about half the steel equipment required for operation on this system in connection with the New York terminal project. The cars are being placed in service as fast as they can be built and cover three varieties of sleeping cars, parlor cars, observation cars, club cars and private cars.

These cars are radically different from the first steel sleeper built and named for the Jamestown Exposition,* where it was exhibited. This car is remarkable for the almost imperceptible effects the subsequent continuous service has left upon it. However, its construction was so heavy as to cause doubts in the minds of railway motive power and operating officials as to its practicability. Realizing this, the Pullman Company endeavored to secure a lighter construction without any sacrifice in structural strength and built five club cars very similar to the present standard designs.

The cars now running and under construction as per the designs here reproduced probably exemplify the highest development of the steel car building art. In general characteristics, appearance and over-all dimensions all classes of these cars are identical. The outside elevation is square with pressed prism plate combination gothics and deck lights, continuous sash rest, round-top high windows of pressed prism plate glass, interlocking steel sheathing of 1½ in. face below the letter board, Pullman standard roof, hood and vestibule. The outside is painted Pennsylvania standard colors and striping so as to secure a uniform train appearance.

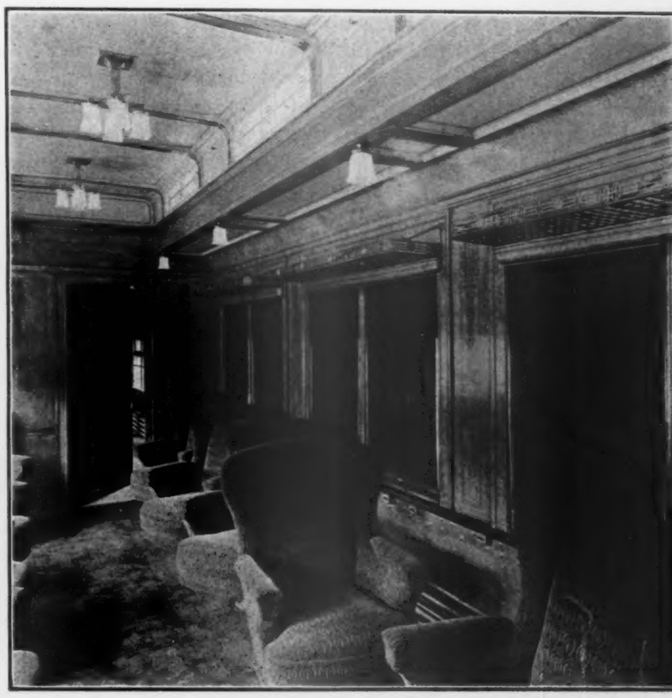


AN ALL STEEL PULLMAN SLEEPING CAR.

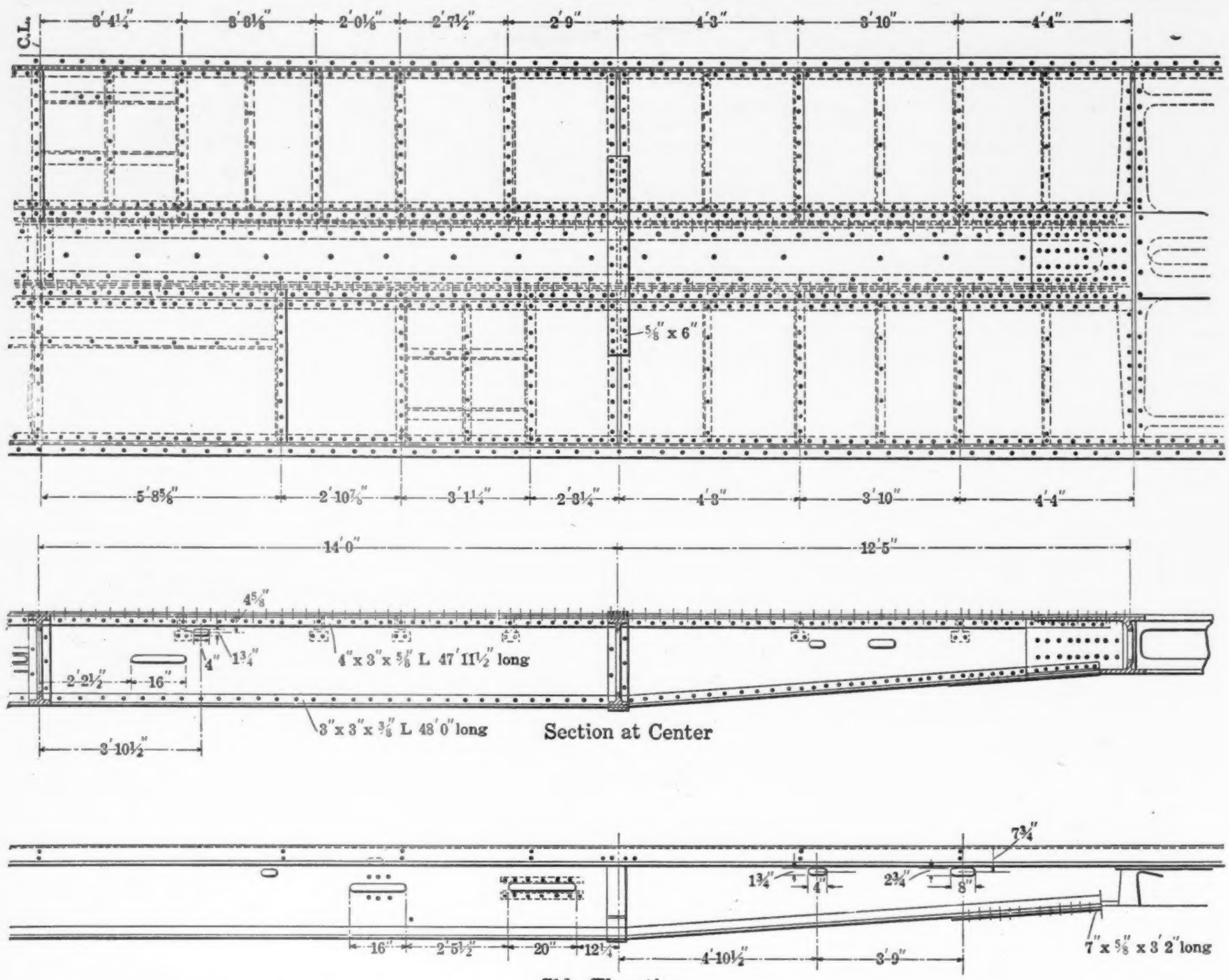
The body of these cars weighs on the average 100,000 pounds and the two trucks 43,500 pounds. This is a very creditable result, the total service weight being but from 12 to 15 per cent.

* See AMERICAN ENGINEER, April, 1907, p. 130.

INTERIOR VIEW OF SLEEPING CAR. THE CEILING IS FLAT.



INTERIOR VIEW OF PARLOR CAR. A BEAMED CEILING IS USED.



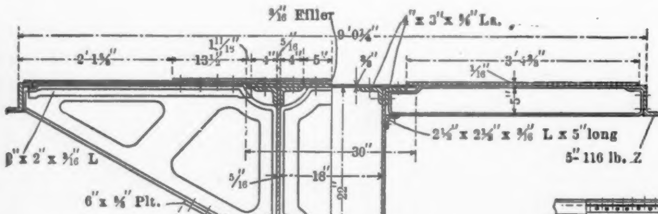

Section at Center

Side Elevation

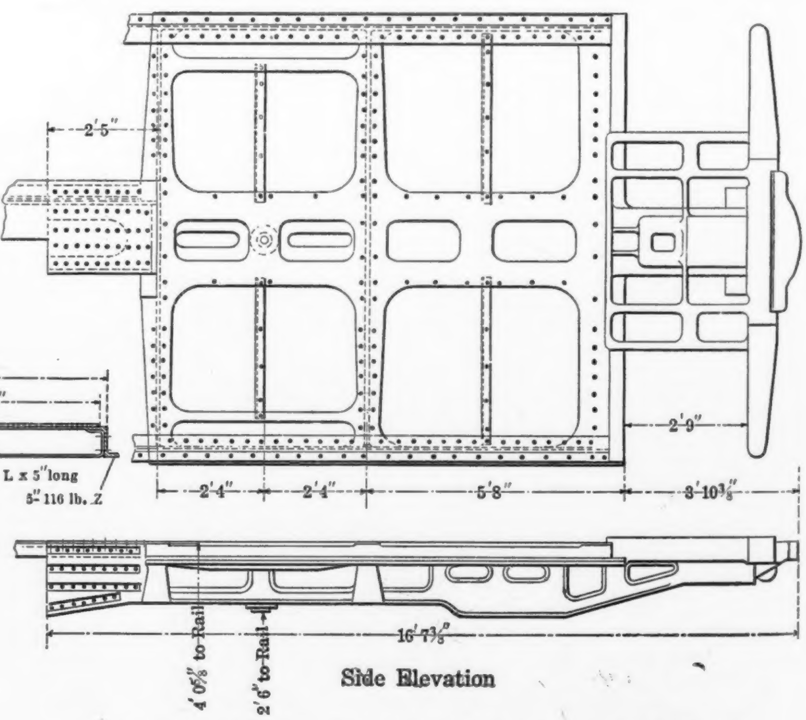
greater than the standard wooden sleeping cars.

FRAMING.

The car is framed to meet M. C. B. recommendations for steel passenger equipment, the same as the Pennsylvania all-steel equipment* with which these cars are to run. The center sills are designed to carry all of the load and resist the service end-shocks. The weight of superstructure and loading is transferred to the center girder at the ends, by the large combined platform and bolster casting and at two intermediate points on each side, by cast steel cantilevers.




SECTIONS AT CANTILEVER AND CROSSTIE.




Side Elevation

THIS UNDERFRAME IS SUITED FOR FOURTEEN DIFFERENT TYPES OF CARS.

The center sills, spaced 18 in. apart, are fish-bellied, built up of a 30 x 3/8 in. top cover plate; 2 upper flange angles 4 x 3 x 7/8 in.; 2 web-plates 5/16 in. x 1 ft. 10 in. deep, continuous between end castings; and 2 bottom flange angles 3 x 3 x 3/8 in.. The whole section provides an area of 50 square inches at the center of the car. The use of heavier angles at the top of the web than at the bottom, together with the heavy cover plate, raises the neutral axis so that it is almost concentric with the line of action of the resultant end

* See AMERICAN ENGINEER, June, 1907, p. 232; July, 1907, p. 260.

VIEW OF FRAMING FOR SLEEPING CAR.

shock. The bending stresses due to eccentric end shock are thus almost eliminated and to the lading stresses but slightly more than the direct compressive end shock stresses need be added to obtain the total stress.

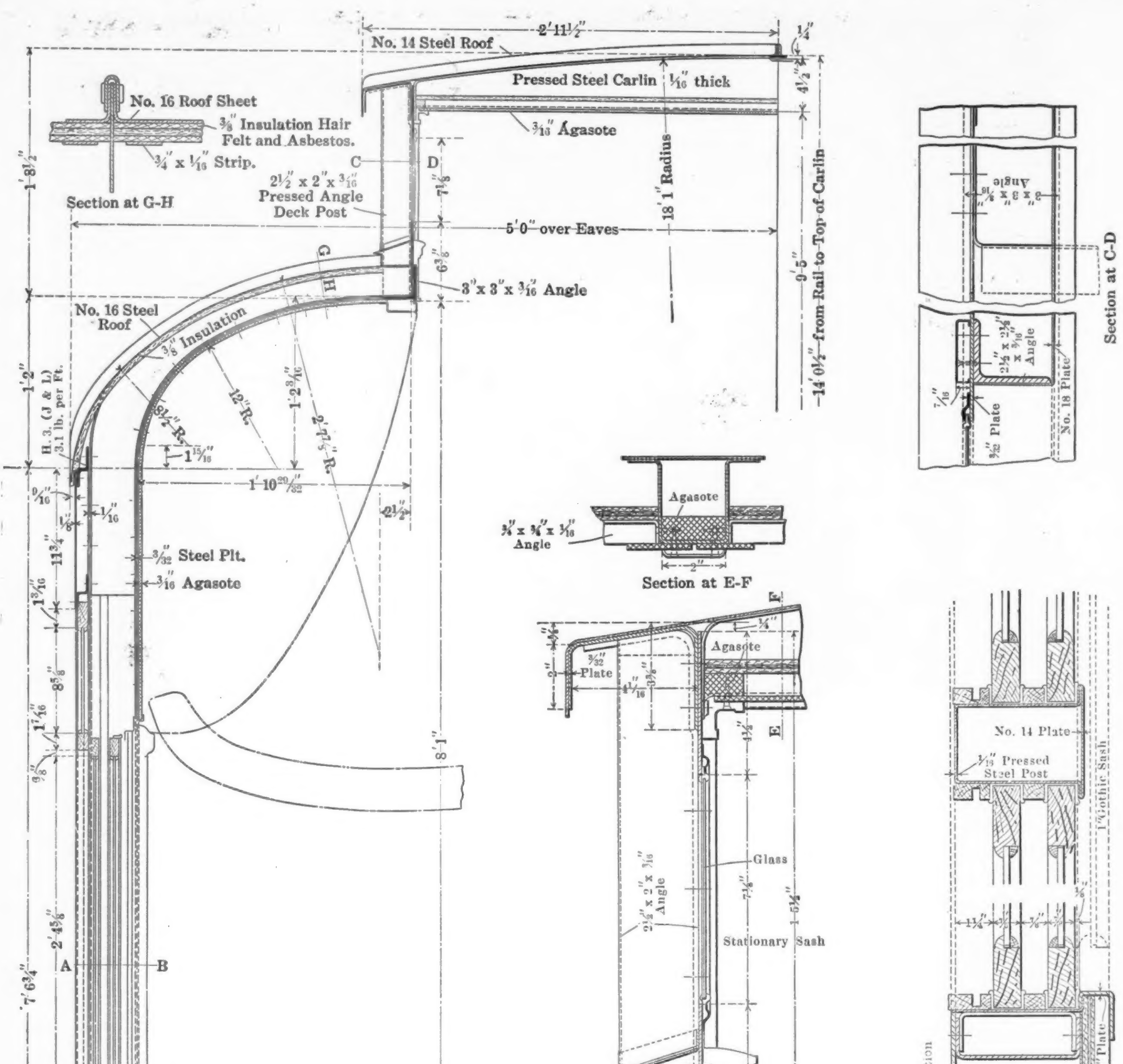
The careful disposition of the metal in the underframe members, thus permits the building of the whole underframe, with a complete covering of floor-plates, under 30,000 lbs. in weight.

This design of underframe, shown in the illustration, will fit under 14 different types of cars without any modification whatever—a feat of interchangeability. The alignment of center and side-sills is permanently assured by the frequent use of pressed steel transverse cross-ties. The same cross-ties, together with floor stiffener angles placed between them, serve as web stiffeners and splices for the floor girder plates which extend from side-sill to center-sill and from end to end of car. This construction produces an admirable floor-girder well suited for resisting the tendency of buckling sidewise, as a whole.

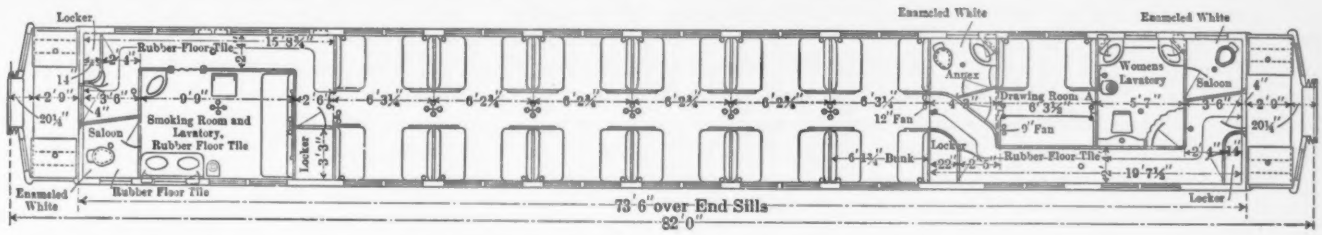
The large platform and bolster-casting is used for the whole structure and detail of the underframe from the buffer-beam to about 12 feet behind the body end-sill. This casting serves for buffer-beam, platform-sills, safety-chain and pipe-anchors, buffing-housing, trap-door and step-supports, body-end-sill, draft-housing, center-sills, double-body-bolsters, side-bearing-braces, center-plate-bearing, and center-sill-splice. It avoids a multiplicity of parts and riveting and withal weighs but 5,150 pounds. It was designed and built by the Commonwealth Steel Co. The center-sill-splice or the connection of the structural sills to the casting, comes approximately at the point of inflexion of the total bending moment on the center-sills, making it eminently safe.

The transverse cantilevers are of cast steel with a center-sill separator between the web-plates, the whole being securely tied

VIEW OF UNDERFRAME. THE COMMONWEALTH STEEL COMPANY'S COMBINATION CASTING IS USED.



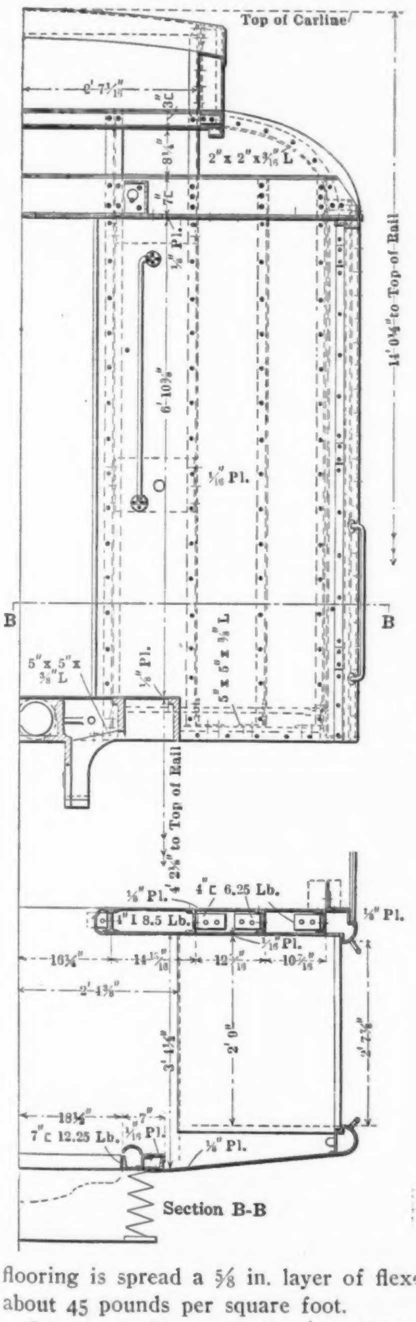

VARIOUS SECTIONS AND DETAILS OF SIDE FRAMING FOR STEEL PULLMAN CARS.

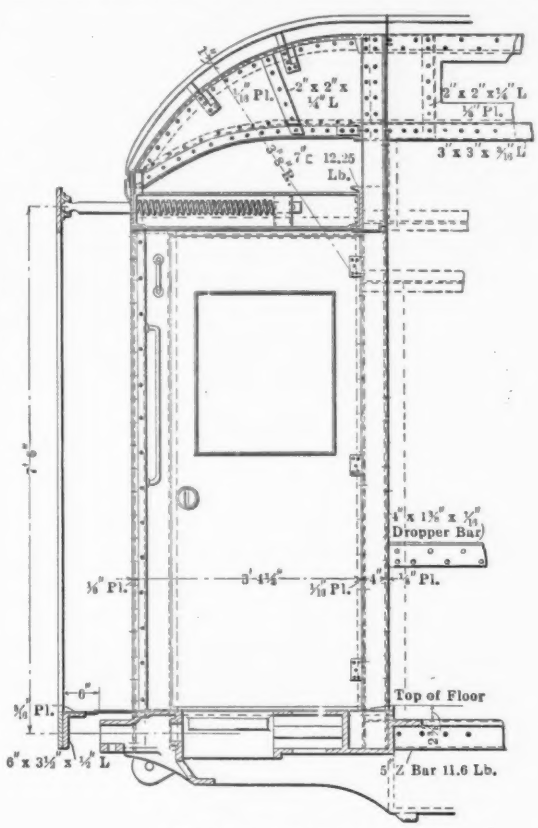


PLAN OF TWELVE-SECTION ALL STEEL SLEEPING CAR—THE PULLMAN COMPANY.

together top and bottom by a 6 x ⅝ in. cover plate, besides being riveted directly through.

The underframe is used for the floor framing direct; above the 1/16 in. floor girder plate is placed a 1 in. layer of magnesia insulation, separated by longitudinal furring strips, to rigidly support the ½ in. keystone flooring. Over the keystone metallic



DETAILS OF VESTIBULE.

flooring is spread a ⅝ in. layer of flexolith. This floor weighs about 45 pounds per square foot.

On the platform, the floor is simply a ⅛ in. plate covering the casting with ¼ in. rubber tiling on top. The floor of the car is not subject to any noticeable vibration and is a good nonconductor of sound.

### The Side Girder.

Due to the use of interlocking steel sheathing, the side girder is placed inside of the car. The lower chord or side sill is a continuous 5 in., 11.6 lb. Z-bar, which section provides the readiest methods of fastening the floor to the side girder, of closing the bottom of the side wall and attaching the sheathing. The upper chord is a 4 x 7/16 x 1⅜ in. continuous dropper bar (Jones and Laughlin) and the web is formed of ⅛ in. steel plates 2 ft. 11¼ in. deep in three lengths per side. The side girder, theoretically, is a continuous beam of three spans, the ends being in a condition somewhere between fixed and freely supported, due to the constraining influence of the steel end casing. The stesses in the side girder do not equal one-third of the permissible amount, the extra metal being required to prevent unsightly deflection in the long central span. This provides for a large degree of elastic deflection, due to overload or service damage, before the car could take a permanent set.

The side girder is stiffened to provide against lateral bending by the strength of the side posts and the two dropper bars, a 3 x ⅜ x 1 in. dropper bar being used outside, where it also serves as the upper attachment for the sheathing and the face connection of the drawn steel sash rest.

Between these two dropper bars and securely riveted to them, pass the pressed steel side posts. The main post is channel shaped, of ⅛ in. steel and continuous from side-sill to deck-sill, so that they form the lower deck carlines. The window posts are U-shaped of 1/16 in. in. steel and extend from side-sill to lower deck eave. From this point to the deck-sill extends a special ⅛ in. pressed carline, forming the lower deck roof joint and the attachment of roof to body of car.

### The Deck Girder.

A continuous 3/32 in. steel plate punched out for ventilators, screens and deck lights forms the deck plate. Securely riveted to it at the bottom is a 3 x 3 x 3/16 in. angle forming the deck-sill and at the top a drawn steel chord forming the eave and water table. The girder is stiffened by upper deck posts of 2 x 3 x 3/16 in. angles.

### The Roof.

Three varieties of carlines are used in the upper deck, all made of ⅛ in. pressed steel. The main carline is of U-shaped section and upon it is made the joint of the inside finish. The carline is furred with agasote and drilled for the finish to screw to it. The intermediate carline is of Z-shaped section and is simply one-half of the main carline, which is used to save weight and for the fastening of transoms. The roof joint carline is of ⅛ in. pressed L-shaped steel and is used to attach the roof to the car.

All three types are riveted to the deck-plate through pressed

end flanges, the rivets taking both the deck-plate and upper-deck chord.

Running longitudinally from end of car to end of car, in the center of the roof is a 1 x 1 x ⅛ in. T-bar securely riveted to each carline, preserving their alignment and forming the attachment for the longitudinal roof sheet flanges and the joint cover.

In the roof there are no rivets whatever extending from the outside to the inside to work loose and leak; even the connection of the lower-deck roof sheets to the deck-plate is outside. The sheets being split in the center are of a size easy to secure, and the flexible joint allows for temperature changes.

INSIDE FINISH.

Inside finish of steel and agasote, in a very unobtrusive design, with conventional stencil decoration is employed. Fireproof agasote is used for upper-deck ceilings, lining of upper berth, section partitions, and section wainscoting.

Vermilion inside sashes, sash rests, window and curtain stops, and seat back mouldings are used. The bunks are all-steel construction, as are the seats; they are painted a burnt red and mottled in finish, which destroys the effect of the flat color, but does not endeavor to imitate wood graining. The upper-deck in all cars is flat, the lower in the parlor cars is likewise flat with ceiling beams.

INSULATION.

The whole car is in reality a double insulated air space, due to the use of "resisto" insulation inside of the cellular sheathing and outside of the steel lining. This insulation is ⅜ in. hair felt sandwiched between sheets of asbestos. Besides the above, the section wainscoting and berth lining still further separate the passenger from the cold outside walls.

LIGHTING.

Provision for electric light only is made and the cars are wired so that either train line or axle device can be used. The great majority of the cars have not had axle devices applied to them as yet.

TRUCKS.

The trucks are of the newest cast steel type, using Lappin steel backed brake shoes, Creco beams, McCord boxes and lids, M. C. B. 5 x 9 in. axle, 36 in. Paige wheels, Woods' roller side bearings and Commonwealth Steel Company's castings. The bolster springs are 5-ply 4 x 7/16 in. steel 36 in. long and the equalizer springs of three-coil 9 x 13 in. of 1½, 1 1/16, 11/16 in. rod.

Westinghouse high speed brake is employed using two cylinders and braking trucks independently to 90 per cent. of the light weight of car.

SPECIALTIES.

Among the specialties are the following: Garland ventilators, exposed Durer hoppers, Knapp sash locks (inside sash), flush sash lifts and post springs (outside sash), Perfection sash balances, Brown metallic weather stripping, Forsyth ring offset shade fixtures, Pitt drawbars, Westinghouse draft gear, Acme diaphragms, vestibule roller curtains and fixtures, National steel trap doors and Pantosote Company's Agasote for inside finish.

## CO-OPERATIVE PLAN OF ENGINEERING INSTRUCTION.

The scheme of instructing students in engineering and similar subjects on the co-operative principle, whereby a certain amount of practical work under regular every-day working conditions is combined with the theoretical instruction in the school, which was originated by Professor Schneider and installed by him in the University of Cincinnati, has attracted widespread attention and is being received with so much favor that other schools and colleges are taking up the idea and devising variations of the original plan to suit the special conditions in each case.

Among the latest of these is the University of Pittsburgh, which has originated a new idea whereby the students get the usual amount of instruction in the college and at the same time get three months each year of practical work in one of the industries around Pittsburgh. In the latest bullettin of the University this plan is described as follows:

"It has been a matter of common observation in connection with the educating of young men who enter the engineering activities that those who spent their vacations while at school in engineering offices and industrial establishments have been better prepared for entrance upon their life's work than their fellow students of otherwise equal abilities who devoted their time exclusively to school work. The contact with the engineering activities, even in this subordinate way, gives the student of engineering an insight into practical affairs which not only makes him of more immediate use to his employer upon graduation from school, but also fits him to pursue his studies to better advantage while in school.

"If the student of engineering is thus benefited by such chance work as he may be able to get during vacation periods, then it is evident that he will be benefited still more by pursuing a systematic course in which the instruction in school is interspersed with suitable outside practical work.

"The technical graduate who has taken school work only has no adequate knowledge of the organization which makes it possible for many men of diverse employment to work together as a single unit in the accomplishment of a desired result, or the system that is necessary for tying together interrelated departments for the attainment of economic production; nor does he even know as a beginner how to apply the knowledge at school in a manner altogether satisfactory to his employer.

"Because of this unpreparedness of the average technical graduate, a number of large corporations have established student apprenticeship courses for the benefit of such graduates as seek employment with them.

"The engineering schools and the companies who employ their graduates are thus working independently in their efforts to prepare young men for entrance upon their life's work. Since both school and future employer have the common aim to fit the young man for efficient service at the minimum of cost in time and money, it is evident that the best results cannot be had by independent action but by co-operation.

"The University of Pittsburgh because of its splendid industrial environment is most favorably situated to apply this co-operative principle to the education of young men who are preparing to enter the engineering industries. Instead of keeping the young man away from the actualities of his life's work for a period of four or more years prior to graduation, as is the general custom of engineering schools, the Committee on the School of Engineering have matured a co-operative plan whereby the student, while spending in school the amount of time usually devoted to instruction in our best engineering institutions, will work four terms of three months each, in the engineering industries of the Pittsburgh District. By this plan the student gets the usual theoretical course and in addition twelve months of practical work, all in the space of four years, the school work being arranged so that successive groups of students will furnish continuous service to the employer."

The schedule of work on this co-operative plan is as follows:

During the first three terms (of from 11 to 12 weeks each) the class is together at the college. In the fourth term of that year it is divided, one-half taking the college work and one-half the practical work. The first term of the following year these halves are alternated and the college work is repeated for the half of the class which was working in the shop during the previous three months. During the next term the sections change places again, as do they also in the third term. In the fourth term of this year the class is united in the college work. During the four terms of the next year the sections alternate regularly and at the end of this year their shop work is completed and the three terms in the following year are devoted entirely to the work in the college. This gives the classes the regular 12 terms in the college work and in addition four terms of practical work in the shops during which time they are earning sufficient to largely reduce the net cost of their education.

TAKE THE SCHOOL TO THE SHOP.—The fundamental principle underlying this work is the thing I want to try to impress upon you; that is, that the prime feature of apprentice training is in the shop and not in the school. In order to get successful mechanics and successful engineers, you have to take the school to the shop and not attempt to take the shop to the school.—*Prof. Schneider at the General Foremen's Convention.*

# British Locomotive Development

A DISCUSSION OF THE RECENT CHANGES IN LOCOMOTIVE DESIGN IN GREAT BRITAIN, THE PROBLEMS WHICH ARE CONFRONTING THE MOTIVE POWER DEPARTMENTS AND THE METHODS BEING EMPLOYED TO SOLVE THEM.

By R. H. Rogers.

A time-honored misconception exists among even prominent railroad men of this country that train service in the British isles cannot be taken seriously in view of the light loads behind the engine; absence of grades and curves, etc., etc., and so deeply have these erroneous ideas become rooted that it is practically impossible to secure serious consideration of a subject which at the present time is certainly not lacking in interest. There is more of a parallel between conditions here and abroad than can possibly be estimated without thorough study on the ground, and the problems which confront them are every bit as difficult of solution as those with which we are so familiar at home.

During a recent trip abroad the writer rode on engines of many British railroads, and he has seen the locomotive on more than one occasion ahead of a train weighing over 400 tons. The ordinary passenger trains of the London and Northwestern; the London, Brighton and South Coast; the Midland, and others average about 280 tons weight behind the engine, and the time of even the unimportant trains is very fast. There are grades as steep as 1 in 40, for a short distance, and rises of 1 in 100 are not unusual on practically any railroad of Great Britain; that is, any railroad can exhibit such gradients. The roads as a whole are far from being level as billiard tables, as many of us have been led to believe, and they are not altogether straight either, although there is, of course, far less curvature than in the United States.

The railroad question of the hour in England is to provide or develop power to continue the justly renowned fast schedules, which for so many years have been in vogue, while the load behind the engine has increased at least 40 per cent. since 1900. When we reflect that the 5.30 P. M. train from London to Crewe on the Northwestern, which consisted in that year of 230 tons, on a schedule of 3 hours and 10 minutes, now weighs 350 tons in 17 minutes faster time, some idea can be gained of the altered circumstances which a few years have brought forth and of the demand which has been imposed on locomotive designers to meet them. Increased power has become an absolute necessity, not so much through increase in speed, but by increase in the weight of rolling stock in proportion to the passengers carried. The slow appreciation on this side of the water of these changed conditions has served to obscure the fact that British locomotive practice is at present in the throes of a metamorphosis which will revolutionize existing equipment, and a mention of what has been done in the transformation of old, and the evolution of new types of engines, is not lacking in interest.

Probably one of the most significant changes in motive power generally in England within the last few years has been the practical retirement of the compound engine. When the twentieth century opened the 3 and 4-cylinder compounds held sway on the London and Northwestern from Carlisle in the north to London in the south, while from Carmarthen in the far west to Peterboro in the east trains were dependent upon these machines for their motive power. All the late Mr. Webb's five classes of 3-cylinder compounds—*Experiments, Dreadnoughts, Teutonics, Greater Britains* and *John Hicks* were at work, as well as a number of his 4-cylinder *Jubilees*, one of which had appeared in 1897 as a 4-cylinder simple engine. These engines were doing fairly good work, but after 1900 the loads increased so rapidly as to outclass each type of engine almost as soon as it appeared, and in consequence a very large proportion of the express trains were double-headed.

No more startling change in motive power on a single road in such a short time could possibly be noticed than in this connection. No line has scrapped as many types of express engines during the past six years as the Northwestern. The old single-wheelers, and all the 3-cylinder passenger compounds, except three of the *John Hicks*, are no more; many of the 2-4-0 *Precedents* have disappeared; a number of the 4-cylinder compounds have been radically altered, and two at least have been rebuilt as simple engines. As all of these engines have since been replaced some idea may be obtained of the enormous outlay which this purely experimental work entailed, but the London and Northwestern owns 2,967 locomotives; its authorized capital is $653,865,603, and its revenue is $75,523,519, so it readily found the money.

It is interesting in this connection to note that although the Northwestern had for years at the head of its locomotive department Mr. Webb, the staunchest adherent of the compound principle, it was practically in the lead to dispense with compounding, and now all British locomotive engineers appear to regard the compound with disfavor, at least for passenger trains. It is quite true that the records of valuable experiments and tests made on many English roads definitely prove that compounding gives an appreciable, though small, saving in freight, and presumably for slow and heavy passenger trains, but they certainly yield no encouragement for fast express work.

The repudiation, or at least the seeming failure of compounding in Great Britain, and there only among foreign countries, is a puzzle certainly difficult to explain. All over Europe we find compounds—especially of the 4-cylinder balanced type—employed for trains at all speeds, including some with 60 miles per hour start to stop runs, with various loads over all kinds of gradients, sometimes very heavy ones. The same is true in India where "de Glehn" engines are reported to be doing splendid work in both freight and passenger service.

It is of interest to discover that recent Great Western practice shows that the success of some French and other engines is due not to the fact that they are compounds, but rather to certain other admirable features. The "de Glehn-du Bousquet" locomotives were the first engines which combined the perfect balance of four cylinders with ample boiler space, large heating surface and very high steam pressure. When tried on the Great Western they gave satisfaction in most ways, but one drawback was soon apparent; the steam entered the low pressure cylinders in a state which owing to the fall in pressure and temperature was little better than water, and after doing its work there more of it was exuded as liquid than went off through the exhaust. In other words, the weak point of these admirable compound engines was their compounding!

Of course, compound engines would gain quite as much and probably more in economy through superheating than simples do; therefore the above mentioned defect in the "de Glehn" would be lessened thereby, and if a re-heater could be fitted between the high and low pressure cylinders it might be cured altogether. But, though no doubt this could be done, there is the bugbear of back pressure to be faced, which such a contrivance seems bound to increase. If compounds be finally abandoned in British practice for express work the writer believes from his observations that back pressure will be the count on which they are condemned.

The thought occurs that the opposition of the locomotive runners to the compound engines had probably as much to do with their failure in England as the same spirit practically defeated

their purpose in this country. The writer knows that the old 4-cylinder type (not Mallets) had few friends on the Baltimore and Ohio, the Erie and other roads with which he has been connected, and although the comment was not so audibly expressed on the other side it was amply in evidence. With the locomotive the engineer is a main factor. If you have the most powerful and efficient locomotive that can be produced, a big difference will appear in performance and efficiency according to whether the engineer is skilful, but above all whether he is in sympathy and accord with the device at hand. An engineer on the Midland railway explained to the writer that notwithstanding the proverbial care taken of all locomotives in England he scarcely had the compound assigned to his run for three days in the week. The principal trouble was with cylinder packing and metallic packing blows, and while these were being periodically repaired he was given a spare compound in not so good condition. Since a simple engine has been placed on the run he made 189 consecutive days with it, 206 miles every day.

It would be interesting to know whether Mr. Bowen-Cooke is of the same mind that he was some ten years ago, when in his lucid and instructive book he advocated general compounding, and highly praised the principle as applied by Mr. Webb, then his chief on the Northwestern. He may have been right, as it does not follow that the late superintendent's failure, any more than M. de Glehn's success, was wholly due to compounding. Mr. Cooke is now in a position to make his own experiments in the light of much new experience, and avoiding his former chief's mistakes may yet design an engine which will vindicate the compound principle, although the latter is certainly fast becoming a dead letter in the United Kingdom.

It is difficult to fully explain the unpopularity of compounding, but two important factors must be mentioned. The favor of the compound locomotive on the continent is partially due to the necessity for obtaining a low pressure exhaust, so that the fire is not torn to pieces. In England, however, with better coal, that factor does not so much apply, and the majority of locomotive superintendents find it better in the end to trust the engineers to work their engines to the best advantage, without any of the restrictions which compounding may impose upon manipulation of the engine.

The compounds become supplanted on the London and Northwestern by what are known as *Precursors* and *Experiments*, the first of which was turned out of the Crewe works in 1904. These engines have inside cylinders 19 in. x 26 in. They are of the 4-4-0 type, with driving wheels 6 ft. 9 in. diameter, steam pressure 175 pounds; heating surface 2,009 sq. ft., and grate area 22.4 sq. ft. The *Experiment*, 4-6-0 type, left the Crewe works in May, 1905, and are of the following dimensions: cylinders, 19 in. by 26 in.; driving wheels, 75 in.; boiler pressure, 175 pounds; heating surface, 1,970 sq. ft., and grate area, 25 sq. ft. The total weight of engine and tender in working order is 102.75 tons. These engines are called upon to work loads far above anything regularly encountered on any other main line in England, although, of course, at a lower speed and over an easier road than the Great Western.

For instance, they are regularly employed on the West Coast Scotch express, which makes the 406 miles from London to Glasgow in 8 hours and 15 minutes, averaging about 50 miles an hour from start to finish. On this run engines are changed at Rugby, Crewe and Carlisle, the latter change being from the Northwestern to the Caledonian, which engine takes it the remaining 103 miles to Glasgow without a stop in 114 minutes.

Some features worthy of mention are the length and width of the coaches, of which eight generally compose this train. They are 65 feet, 6 inches long, and 9 feet wide, the entire length of the train over buffers being 556 feet. This complete train, which includes two dining cars, is vestibuled throughout, with side aisles or corridors, and weighs about 380 tons. It was built at Wolverton in 1908 and constitutes a radical departure from the former English type of carriage. The train is steam-heated on the direct system, there being a controlling valve in each compartment, enabling the passengers to regulate the temperature. The luminant employed is electricity generated on Stone's system.

As may be appreciated from the above brief description of a famous run, the *Precursors* and *Experiments* are efficient engines. Three hundred and eighty tons hauled at a speed often exceeding 72 miles an hour is no mean performance, and these trains are marvels of punctuality, but even after all this good showing Mr. Cooke is not resting, because these successful engines were designed by the late Mr. Whale, and he is planning a daring type of his own. These will be 4-6-2 tank type, and the writer designates the idea as daring as it seems rather inconsistent to put up a tank engine on such a scale. Unfortunately the dimensions were not obtainable when the writer was at Crewe, but it appears that the tanks will hold about 1,700 gallons of water, and the coal capacity of the bunker will be about three tons. It is a matter of little moment how much the tanks contain as the Northwestern is replete with track troughs, but there is not much appeal in the small capacity of the coal bunker. However, engines are changed frequently, as has been mentioned, the longest stretch being from Crewe to Carlisle, 140 miles, and they may be able to get through.

Tank engines for some reason not apparent to the writer are becoming tremendously popular in that country in all classes of service, although none have been yet evolved on the ambitious lines proposed by Mr. Cooke. They do splendid work on the suburban and shorter runs, but, from an American viewpoint, the design scarcely appears consistent for long and hard nonstop service. The writer observed one of these recently on the Brecon and Merthyr railway which being typical in its dimensions is worthy of some special mention. It was one of four, of the 0-6-2 type built by Robert Stephenson & Co., Ltd., of Darlington, to the design of the Locomotive Superintendent of the above road, Mr. James Dunbar, for working heavy mineral traffic. The test performance, which the writer was fortunate enough to witness, consisted in the hauling of 11 ten-ton freight cars, fully loaded, and a brake van up a grade of 1 in 40. The principal dimensions of this engine were as follows: cylinders, 18½ in. by 26 in.; coupled wheels, 4 ft. 6 in.; radial wheels, 3 ft. 6 in.; fixed wheel base, 15 ft. 3 in.; total wheel base, 21 ft. 9 in.; heating surface, tubes, 1,296 sq. ft.; heating surface firebox, 120 sq. ft.; total heating surface, 1,416 sq. ft.; grate area, 21 sq. ft.; working pressure, 175 pounds. The adhesive weight in working order is 54 tons, 6 cwt., and the total weight 67 tons. The tanks have a capacity of 1,740 gallons, and the bunkers will accommodate 3 tons of coal. These engines are fitted with automatic vacuum brake so that they can be used, if necessary, in working passenger trains.

It is impossible within the confines of a single article to make full mention of the vast strides which have been made on all of the railroads of England, and some little prominence was given to the London and Northwestern because the writer believes it to be one of the greatest and most progressive lines in the United Kingdom. Its management has not been handicapped by blind adherence to ancient ideals which has characterized many of the others. It was the first to abolish, or practically abolish, the time-honored side door compartment carriage in favor of the much more sensible corridor car, and although the corridor is on the side and the compartments exist as of yore, the train can be traversed from end to end, and it is only a question of time before the aisle will be found in the center of the car as in our practice. In the through service the Northwestern was the pioneer in abolishing the second class carriage and improving the third to at least equal the second, and many of the remaining trunk lines are fast following in the wake of this improvement.

The writer has no intention of asserting that the next few years will bring about a revolution in favor of American standards on English railroads, but the trend seems to be certainly in that direction. Caste lines have been largely eliminated, to which the new arrangement of the cars mutely attests, and many of the old traditions have been rudely shattered. This is noticeable in the slow but sure growth in favor of the outside cylin-

ders; fairly comfortable cabs in lieu of the former wind shields, and a much more simple arrangement of the cab fittings. Although in connection with the latter feature there is still much to be absolutely condemned, the fact remains that the improvement which only a few years has brought about is startling.

It was noticeable in the Crewe shops, and in the Swindon works, that far less money is thrown away in repairs than was formerly the practice. The definition "thrown away" is about the only real measure of the situation, because pedestal binders were actually planed, put into a vise and draw-filed and polished, and bolt heads under the engine where no one could possibly see them had their hexes filed to a gauge and polished. This has all been sensibly dispensed with, and no doubt the money saved in classified repairs put to a better purpose. The resentment which formerly prevailed against equalizers has largely disappeared. The writer recalls that on a former visit to England in 1899 he did not notice a single set of equalized driving springs. He spoke to Mr. John McIntosh, Locomotive Superintendent of the Caledonian at that time, regarding the omission of this very useful device, but it appeared that the perfection of the roadbed was considered sufficient to warrant hanging the springs independently. There are many equalized engines in England at this writing. The engineers of the London, Brighton and South Coast say that the riding of the engines has been improved fifty per cent., and the records of the running sheds or roundhouses show a diminished application of springs of about one hundred per cent. The mention of these things is simply to emphasize the presence of the wave of common sense reform which, although long delayed, we have all felt some day would sweep over English railroad practices.

What the future will bring forth can only be conjectured, but the writer firmly believes that the British locomotive of 1920 will be as far removed from what is running there now as the *Precursor* of to-day is from the Webb compound of 1900. There will be eleven cars before long on the Scotch expresses, as there are frequently now on the American boat train specials. The economics of present day administration discountenance the splitting of trains into sections with the resultant double expense, and insist on adequate power to move them as a single unit. This may explain why midnight oil is now being burned in the motive power offices of the great railroads where only a short time ago after hours they were as gloomy as the tombs.

So many elements enter into the making of success or failure of an express engine under twentieth century conditions of speed and load, that it needs long trial and much investigation to settle which are the exact things that make an engine's work good or bad. For example, with the old D slide valves the latest Swindon engines would never have given the results which they now yield; piston valves, giving a big opening for a small movement of the valve itself, are essential with exhaust ports of 10 inches in the two cylinder engines, or 8 inches in the 4-cylinder ones; and it is just these big ports and a free exhaust throughout, that makes them such remarkably speedy machines.

Mr. Churchward designed these engines, both in Atlantic and six-coupled form, which preserved all the good points of the "de Glehn" and another, viz., the Walschaert valve gear, but they are "non-compounds." These were cheaper to build and also proved most economical engines in actual working. It was thought at first that 225 pounds of steam must be wasteful when used only once, but worked with an early cut-off in very long cylinders, this has not proved so in practice. Under any conditions they were found able to do all, and rather more, than the "de Glehns" had done, at least in England, and at less cost. One special advantage claimed for the "de Glehn" was that at starting, or when a special effort was needed on a hill, live steam could be sent into the big low-pressure cylinders. The Swindon 4-cylinder engines, however, working without this advantage, give wonderful up-hill speeds, rising to 67 miles an hour on a grade steeper than 1 in 200, with a good average load.

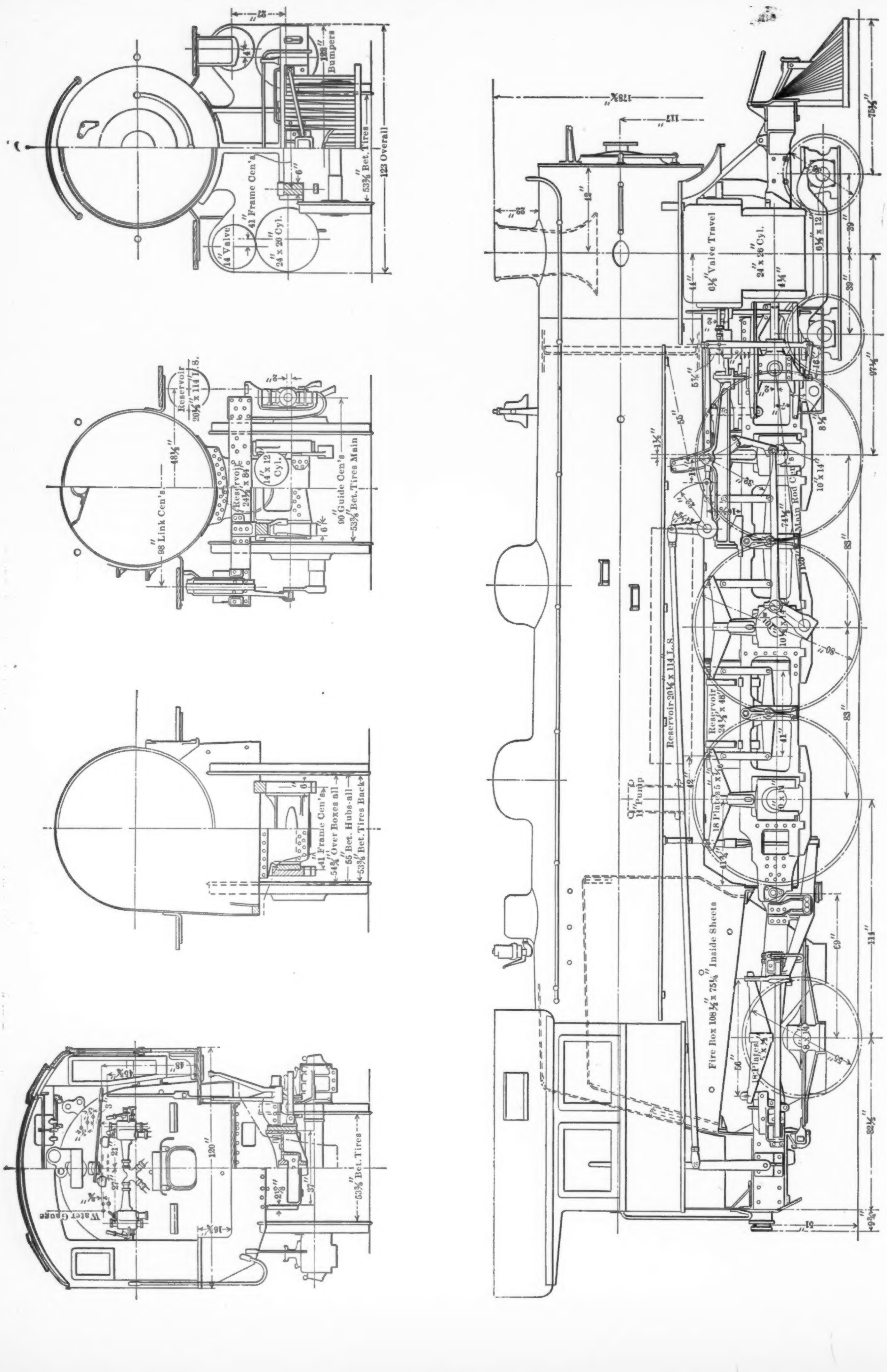
Some time ago there was considerable discussion relative to the advisability of lowering the pressure on the "super-heated" 6-coupled engines of the Great Western, but this project has been finally abandoned and the original pressure will be maintained. No doubt the combination of so high a pressure with hot and quite dry steam does mean the drying up of oil when that is supplied in the ordinary way. It was quite in evidence in connection with some of the 2-8-0 class on the Great Western and on one of these engines the pressure was lowered by about 20 pounds and it proved a distinct gain, but for fast passenger work the "spring" in high pressure steam is of unquestioned value, and with their usual ingenuity the Swindon works staff have met and overcome the lubrication difficulty They are now fitting a jet of (wet) steam, which as the inlet valves open discharges a spray of oil into the cylinder. It is thought that wherever the steam is blown a drop of oil is also carried, and this means a complete lubrication of the piston's path as it moves at every stroke.

The ingenuity displayed by its motive power men prestiges well for the future of the English locomotive. Much has been done, but much more remains, and the present is the crucial period. It is unfortunate that more uniformity of ideas does not prevail among the various designers such as might be secured by the presence of an association of scope corresponding with the American Railway Master Mechanics, and doubly unfortunate that so much money has been needlessly spent on weird types of engines which scarcely had even an experimental value.

It is now largely realized, however, that simplicity and general reliability are far more important features than refinements of design, and special devices can rarely be employed. It is known that the heavy corridor train from a novelty has now become an institution, and it is appreciated that the 4-6-0 or 4-6-2 type is the most efficient to handle it with economy and with dispatch. The ground thus narrowed down to a working basis, for passenger service at least, effectually eliminates the single driver freaks and other monstrosities which got along fairly well when the carriages were shells and five of them made up a train, but admit of no more comparison with the modern locomotives of the Great Western to-day than a hansom does with a taxicab. The British traveler, although not inclined to be unduly critical, now demands something vastly better than his presumed to be adequate facilities of a decade ago, and the management of the various railroads are sincere in their intention to give it to him without the sacrifice of one solitary minute of running time; hence the outcome is awaited in much curious expectancy by those who have made any study of the situation.

MOTOR CONTROL FOR MACHINE TOOLS.—Equally important with the choice of motors is that of control. In selecting the control it is necessary to consider the nature of the work, its accessibility to the operator, the method of attaching it to the tool and in some cases its relative position to other tools; for instance, an open type starting rheostat should not be exposed to danger of short-circuit from flying chips. In the majority of cases, a shunt motor of ¾ h. p. and less would be started by a switch. Exceptions to this would be motors on tools that must be gotten under way slowly, and grinders driven by direct-current motors for reasons of safety. With adjustable-speed motors, care should be taken to throw the switch on full field. Series motors up to 8 h. p. or even larger can be started by switch. Exceptions to this would be cranes and tools requiring a certain amount of armature speed regulation. Larger motors, for tools where starting service is infrequent or not severe, and for lineshafts and for group drivers, would be satisfactorily operated with a dial type controller, which is cheaper than the drum controller, provided, however, that the controller is placed in a protected position.—*Chas. Fair before A. S. M. E. and A. I. E. E.*

LEATHER BELTING.—Single belts will stand a stress of 60 pounds per inch of width with occasional taking up and will have a fairly long life, provided the pulleys are not too small. The permissible stress for double and triple belts is 105 and 150 lbs., respectively.

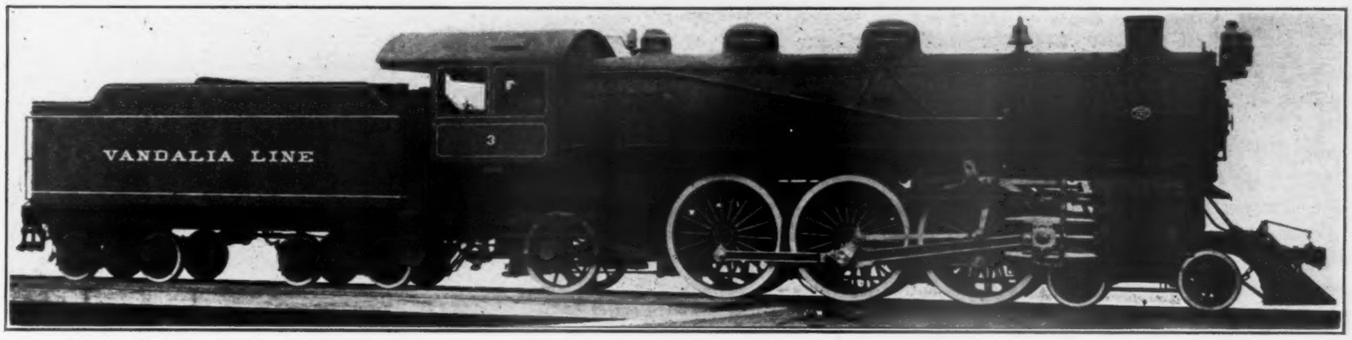



POWERFUL PACIFIC TYPE LOCOMOTIVE FOR THE VANDALIA.

# Heavy Pacific Type Locomotives

VANDALIA LINE.

Until recently an Atlantic type locomotive having a total weight of 185,000 lbs., weight on drivers of 107,500 lbs., cylinders 21 x 26 in., and a maximum tractive power of 24,650 lbs., has been the standard class of passenger locomotive used on the Vandalia Line. During the past few years, however, the requirements in passenger service have increased to such an extent that a heavier locomotive than can be provided in the Atlantic type is now needed to handle certain of the trains. In consequence, in ordering new passenger equipment from the American Locomotive Company in December, 1909, it was decided to include four heavy locomotives of the Pacific type to be used on some of the most important trains.




LOCOMOTIVE THAT PULLS A TWELVE-CAR TRAIN AT 65 MILES PER HOUR.

Prior to the advent of these engines, the Vandalia was one of the few important roads in the country on which the Pacific type locomotive had not been adopted for at least the most difficult passenger service. In fact, because of the favorable service conditions on this line, both the freight and passenger traffic have hitherto been handled altogether by the lighter classes of motive power. The Mogul type of engines is at present the standard class for freight service, and the equipment includes the heaviest examples of this type so far constructed. The last Mogul engines built for this road by the American Locomotive Company had a total weight of 187,000 lbs., 159,300 lbs. on driving wheels, 21 x 28 in. cylinders, and a maximum tractive power of 33,300 lbs.

The engines here illustrated have now been in service for two months on the St. Louis Division. Although designed for fourteen car trains, they have not up to date had occasion to handle more than twelve cars to a train. Officials of the road report that the service with the trains of that size have been very satisfactory and gives every indication that there will be no difficulty in meeting the more severe requirements which will be put upon them in the winter time. In their report, the officials make particular mention of the easy riding qualities of the engines, stating that they ride remarkably well at a high rate of speed (60 miles per hour and upward). They are operating under easy grade and curvature conditions. There are, to be sure, a number of portions of the road of from three to ten miles long where the curves are numerous; but the sharpest curve on the division is only 3 deg. 48 min., and there are long straightaway stretches with very few curves.

As to the grades, the total rise between St. Louis and Summit, a distance of 217.8 miles, is only 474 ft. This rise, which is against eastbound traffic, is accomplished by a series of short, easy ascents over rolling territory with long stretches of practically level track in between. Practically the only grade of any consequence against eastbound traffic lies between Reelsville and Almeda, Ind., where in a distance of approximately 8 miles, the total rise is 216 ft., giving an average gradient of 0.503 per cent. Going in the other direction, the grade conditions are still easier, there being several long, easy slopes in favor of westbound traffic.

The following table gives a record cf eight typical runs of some of the most important trains between Indianapolis and Terre Haute, and the latter place and St. Louis:

| Train | Date. | Terminals of Run. | Dist. Mi. | No. of cars. | (Tons) Tot. wt. train, incl. eng | Sched. time, incl. stops | Run. time, incl. stops | Tot. water used. Gals. | Approx Tot. coal used. lbs. | Coal used per hr. lbs. | Lbs. of coal sq. ft. grate area pr. hr. | Highest. speed M H.P. | Exhaust tip Diam. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 7-12 10 | **Indpls. to Terre Haute.** | 73 | 10 | 800 | **1 hr. 42 min.** | **1 hr. 40 min.** | 5700 | 7000 | 4200 | 74.5 | 60 | 6″ | **Eng. steamed poorly. Indiana coal, heavy rain.** |
| 14 | 7-13 10 | **Terre Haute to Indpls.** | 73 | 10 | 825 | **1 hr. 50 min.** | **1 hr. 50 min.** | 5700 | 7000 | 3818 | 67.5 | 60 | 6″ | **Indiana coal.** |
| 21 | 8-3 10 | **Indpls. to Terre Haute.** | 73 | 12 | 825 | **1 hr. 42 min.** | **1 hr. 46 min.** | 6000 | 7000 | 3965 | 70.2 | 65 | 6¼″ | **Indiana coal.** |
| 14 | 8-4 10 | **Terre Haute to Indpls.** | 73 | 11 | 875 | **1 hr. 50 min.** | **1 hr. 48 min.** | 5700 | 5200 | 2885 | 51.0 | 60 | 6¼″ | **Indiana coal, heav fog and mist** |
| 21 | 8 4 10 | **Indpls. to Terre Haute.** | 73 | 8 | 715 | **1 hr. 42 min.** | **1 hr. 34 min.** | 5100 | 6000 | 3830 | 67.8 | 65 | 6¼″ | **Indiana coal, fine and dirty, heavy quarte ing wind.** |
| 7 | 8-12 10 | **Terre Haute to St. Louis.** | 175 | 7 | 650 | **4 hrs. 30 min.** | **4 hrs. 13 min.** | 12400 | 13000 | 3065 | 54.6 | 75 | 6¼″ | **Indiana coal.** |
| 20 | 8-13 20 | **S Louis to Terre Haute.** | 175 | 8 | 740 | **4 hrs. 11 min.** | **4 hrs. 11 min.** | 14200 | 15500 | 3720 | 65.9 | 75 | 6¼″ | **Hard Running Train Ill. Coal.** |
| 21 | 8-18 10 | **Indpls. to Terre Haute.** | 73 | 9 | 710 | **1 hr. 42 min.** | **1 hr. 36 min.** | 5900 | 6000 | 3750 | 66.3 | 75 | 6¼″ | **Indiana coal, rain and quartering wind.** |

When the engines were first put into service it was necessary to make some minor changes in the front end arrangement, which was the Vandalia standard. After that the engines steamed freely and no trouble was experienced.

"Schedule Time" and "Running Time" in the above table includes in each case all stops. Trains 21 and 14 between Indianapolis and Terre Haute make three and two regular stops, respectively. While between Terre Haute and St. Louis train No. 7 makes four regular stops, and train No. 20 three. From this table it is apparent that these engines have no difficulty in maintaining the train schedules.

An examination of the figures for the coal consumption indicates that the engine was not pushed to the limits of its capacity on any of the runs. From this table it will be noticed that the highest rate of coal consumption per square foot of grate area per hour (which was calculated from the data furnished by the railroad company) is only 74.5 lbs. The figures for the total amount of coal used per trip, in view of the tonnage and speed maintained, are also very creditable.

Although the design incorporates no new or unusual features, it is an excellent example of a straightforward, well proportioned design carefully worked out to meet the particular conditions of service for which the engines were intended. That the engines are well adapted to meet the requirements, is shown by the train records in the above table. The design is entirely new and follows in general the builders' standard practice.

As far as the cylinders and running gear are concerned, it is practically identical with the engines of the same type built by the American Locomotive Company for the Pennsylvania Railroad,* the use of which on the Vandalia road was prohibited by the limit of 55,000 pounds for the allowable load per driving exle. The principal differences between the two designs are a reduction of the boiler pressure from 210 to 200 lbs. and use of a smaller boiler and firebox, the boiler of the Vandalia locomotive being 76½ in. in diameter outside at the first ring; while this dimension in the Pennsylvania locomotives is 79¾ in. The boilers of both locomotives are of the straight top type, and the tubes in each case are 21 feet long.

In regard to the firebox, that of the engines here illustrated is 108⅛ in. long by 75¼ in. wide, having a grate area of 56½ sq. ft.; while that of the Pennsylvania locomotive is 111 in. long by 80¼ in. wide, and has a grate area of 61 8/10 sq. ft.

These modifications in design result in a reduction of 14,000 lbs. in the total weight of the locomotive. The Vandalia engines have a total weight of 256,000 lbs. as compared with a total weight of 270,000 lbs. for the Pennsylvania locomotives.

Although the reduction of 10 lbs. in the boiler pressure reduces the maximum tractive effort of the engines here illustrated 2,600 lbs., as compared with that of the locomotive built for the Pennsylvania, at 60 miles per hour there is only 600 lbs. difference between the tractive efforts of the two locomotives calculated in accordance with the builders' formula.

The general design is shown in the accompanying illustrations and the general dimensions and principal ratios are given in the following table:

GENERAL DATA.

| | |
|---|---|
| Gauge | 4 ft. 8½ in. |
| Service | Passenger |
| Fuel | Bit. Coal |
| Tractive effort | 31,800 lbs. |
| Weight in working order | 256,000 lbs. |
| Weight on drivers | 162,000 lbs. |
| Weight of engine and tender in working order | 401,900 lbs. |
| Wheel base, driving | 13 ft. 10 in. |
| Wheel base, total | 35 ft. 2½ in. |
| Wheel base, engine and tender | 66 ft. 5 in. |

RATIOS.

| | |
|---|---|
| Weight on drivers ÷ tractive effort | 5.10 |
| Total weight ÷ tractive effort | 8.05 |
| Tractive effort × diam. drivers ÷ heating surface | 580.00 |
| Total heating surface ÷ grate area | 77.50 |
| Firebox heating surface ÷ total heating surface, per cent | 4.43 |
| Weight on drivers ÷ total heating surface | 37.00 |
| Total weight ÷ total heating surface | 58.50 |
| Volume both cylinders, cu. ft | 13.60 |
| Total heating surface ÷ vol. cylinders | 322.00 |
| Grate area ÷ vol. cylinders | 4.15 |

CYLINDERS.

| | |
|---|---|
| Kind | Simple |
| Diameter and stroke | 24 x 26 in. |

VALVES.

| | |
|---|---|
| Kind | Piston |
| Diameter | 14 in. |
| Greatest travel | 6½ in. |
| Outside lap | 1¼ in. |
| Inside clearance | ⅛ in. |
| Lead at 6½ in. cut off | ¼ in. |

WHEELS.

| | |
|---|---|
| Driving, diameter over tire | 80 in. |
| Driving, thickness of tire | 4 in. |
| Driving journals, main, diameter and length | 10½ x 14 in. |
| Driving journals, others, diameter and length | 10 x 14 in. |
| Engine truck wheels, diameter | 36 in. |
| Engine truck, journals | 6½ x 12 in. |
| Trailing truck wheels, diameter | 55 in. |
| Trailing truck, journals | 8 x 14 in. |

BOILER.

| | |
|---|---|
| Style | Straight |
| Working pressure | 200 lbs. |
| Outside diameter of first ring | 76½ in. |
| Firebox, length and width | 108⅛ x 75¼ in. |
| Firebox plates, thickness | ⅜ and ½ in. |
| Firebox, water space | 4½ in. |
| Tubes, number and outside diameter | 383—2 in. |
| Tubes, length | 21 ft. |
| Heating surface, tubes | 4,195 sq. ft. |
| Heating surface, firebox | 194 sq. ft. |
| Heating surface, total | 4,389 sq. ft. |
| Grate area | 56½ sq. ft. |
| Smokestack, diameter | 20 in. |
| Smokestack, height above rail | 14 ft. 10¾ in. |

TENDER.

| | |
|---|---|
| Tank | Waterbottom |
| Frame | 10 and 12 in. channels |
| Wheels, diameter | 36 in. |
| Journals, diameter and length | 5½ x 10 in. |
| Water capacity | 7,500 gals. |
| Coal capacity | 12 tons |

* See AMERICAN ENGINEER, July, 1907, p. 267.

## THE STANDARDIZATION OF MOTOR DRIVES FOR MACHINE TOOLS.

At the Rochester convention of the National Machine Tool Builders' Association the Committee on the Standardization of Motor Drives for Machine Tools made a report of progress of its negotiations with the committee of the American Association of Electric Motor Manufacturers. Seven points have been agreed upon, but the final adoption of the new standard practice by the two associations has not yet come up for formal action. The schedule as agreed upon is as follows:

1. *Horsepowers.*—It is thought that the following horsepowers will meet practically all the requirements of electric drives for machine tools: 1, 1½ (for D. C. only), 2, 3, 5, 7½, 10, 15, 20 and 25. Though it was agreed that horsepowers more than 25 and less than 1 are used, it was not thought advisable to embody them at the present in the attempted standardization, but it was held out that they might be embodied some time in the future among the standardized sizes.

2. *Voltage.*—It is recommended that for D. C. motors 115 and 230 volts be adopted as standard, and for A. C. motors 110 and 220 volts.

3. *Horsepower Ratings for Drives.*—It is recommended that the horsepower ratings for machine tool drives be the standard ratings of the American Association of Electric Motor Manufacturers—*i. e.,* (a) that motors be given the continuous constant horsepower rating where approximately standard load conditions exist; (b) for adjustable speed motors used for intermittent service the standard two-hour continuous duty rating be used for ordinary shop conditions, and that the name plates of such motors indicate the time as well as horsepower ratings of the motor, and further that the horsepower be figured at the high as well as the low speed for adjustable speed service.

4. *D. C. Motors.*—It is the recommendation of the joint committee that constant speed motors, adjustable speed with a range of 2 to 1, and adjustable speed motors with a range of 3 to 1, be included in the attempt at standardization. It is the opinion that this will cover practically all the requirements of the majority of machine tool manufacturers, and these ratios are recommended for the guidance of tool and motor designs.

This does not exclude the occasional use of motors with a different speed range, such as 4 to 1, or even more, but it was the opinion of the committee that motors with a higher range of speed than 3 to 1 are not used to a sufficient extent and are not so absolutely necessary for machine tool construction, as to

include them among the standardized motors.

5. *Speeds.*—The following table of speeds is recommended as the standard for adjustable speed D. C. motors:

| Hp. | 2 : 1 | 3 : 1 |
|---|---|---|
| 25 | 900—450 | 900—300 |
| 20 | 900—450 | 900—300 |
| 15 | 1,200—600 | 1,200—400 |
| 10 | 1,200—600 | 1,200—400 |
| 7½ | 1,200—600 | 1,200—400 |
| 5 | 1,200—600 | 1,200—400 |
| 3 | 1,500—750 | 1,500—500 |
| 2 | 1,500—750 | 1,500—500 |
| 1½ | 1,500—750 | 1,500—500 |
| 1 | 1,500—750 | 1,500—500 |

The tendency of the electrical manufacturers is of course toward higher speed motors, but it was thought desirable by the committee to hold out for lower speeds, on account of mechanical difficulties in gear and chain driving when higher speeds are used. The schedule as given above is a compromise, and will allow of motor drives with reasonable linear speed of first driving gears, and limits the number of revolutions of the motor to within the limits given by chain makers for the proper speed of their chains.

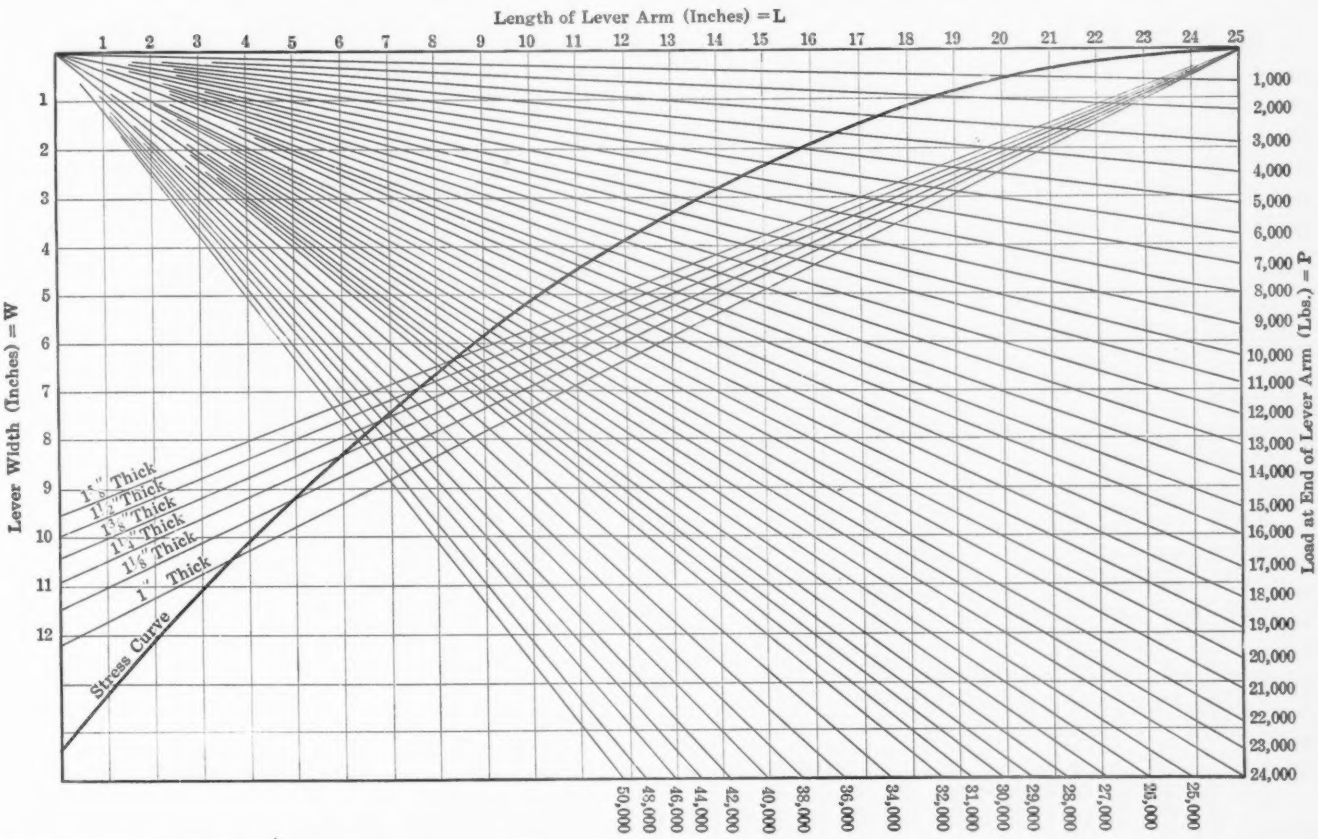
6. *A. C. Motors.*—It is recommended that the following table of polyphase 60-cycle A. C. motors be adopted:

| | | | |
|---|---|---|---|
| 25 hp. | 900 and 600 | 5 hp. | 1,200 |
| 20 hp. | 900 and 600 | 3 hp. | 1,200 |
| 15 hp. | 900 and 600 | 2 hp. | 1,200 |
| 10 hp. | 1,200 and 600 | 1 hp. | 1,800 and 1,200 |
| 7½ hp. | 1,200 and 900 | | |

7. For the consideration of the constant speed A. C. motors, 60 cycles is to be used as the basis.

## DESIGN OF BRAKE LEVERS.

A chart for the determination of the width and other features of brake levers devised by Fred. W. Pennington, Westinghouse Air Brake Co., appeared in the June issue of the *Air Brake Magazine,* and is reproduced below. With this diagram it is possible to quickly obtain the width through the middle pin hole when the forces on the lever, the thickness, and the distance between pin centers are determined. The thickness should be such that the bearing pressure between lever and middle pin shall not exceed 23,000 lbs. per sq. in. (M. C. B.).




The following example will illustrate the use of the diagram: Assuming a lever 1 in. thick with arms 20 in. and 15 in. in length, and forces at the ends of the arms, 7,500 and 10,000 lbs. respectively; first, locate the line at the right of the diagram corresponding to the force of 10,000 lbs. and follow this line to its intersection with the vertical line, 15 in.; then move horizontally to the "stress curve," moving vertically from this point to the line marked "1 in. thick." By following a horizontal line through this point to the left side of the chart, the lever width is found to be 6¼ in. The same result, of course, would be obtained by using the force, 7,500 lbs. and 20 in., the corresponding length of arm.

In case the arm of the desired lever is greater in length than 25 in., which is the limit of the diagram, this length should be divided by 2 and the corresponding force multiplied by 2 before proceeding as shown in the above example. In this diagram the effect of the pin hole on the strength of the lever is neglected.

Motor Car for Southern Railway.—The Southern Railway Company is having built a McKeen motor car which will have an extreme length of 72 feet 10 inches, and will be divided into four compartments, one to accommodate the engine, the baggage and express room, and two passenger compartments designed for the separation of the races, one having a seating capacity of forty and the other of eighteen. These compartments will have separate entrances, and each will have its own lavatory, water cooler, and other conveniences. The body of the car is of all steel construction, of torpedo design.

Intelligent Workmen Cause No Trouble.—The more intelligent our workmen are, the less trouble they will give us. It is the floating element which causes trouble. The really skilled mechanic wants to rise on his own ability and when he sees that the manufacturer gives him the opportunity to better himself, by showing individual effort, he is apt to become a persistent and loyal member of the organization under which he is working.—*B. M. W. Hanson before the Hartford Mfrs.' Assoc.*

# Locomotive Performance on Grades of Various Lengths*

IT IS GENERALLY RECOGNIZED AMONG PRACTICAL OPERATING MEN THAT LOCOMOTIVES SEEM TO DECREASE IN POWER OR GET TIRED ON VERY LONG GRADES. THE AUTHOR INVESTIGATES THE CAUSES OF THIS CONDITION AND DETERMINES THE POINT OR DISTANCE ON THE GRADE WHERE THIS GENERALLY OCCURS

By Beverley S. Randolph.

While engaged in such studies some years ago the attention of the writer was attracted by the fact that the usual method of calculating the traction of a locomotive—by assuming from 20 to 25 per cent. of the weight on the drivers—was subject to no small modification in practice.

In order to obtain a working basis, for use in relation to this feature, he undertook the collection of data from the practical operation of various roads. The results are given in Table I, from which it will be seen that the percentage of driver weight utilized in draft is a function of the length as well as the rate of grade encountered in the practical operation of railways.

In this table, performance will be found expressed as the percentage of the weight on the drivers which is utilized in draft. This is calculated on a basis of 6 lb. per ton of train resistance, for dates prior to 1880, this being the amount given by the late A. M. Wellington, M. Am. Soc. C. E.,† and 4.7 lb. per ton for those of 1908-10, as obtained by A. C. Dennis, M. Am. Soc. C. E.,‡ assuming this difference to represent the advance in practice from 1880 to the present time. Most of the data have been obtained from the "Catalogue of the Baldwin Locomotive Works" for 1881, to which have been added some later figures from "Record No. 65" of the same establishment, and also some obtained by the writer directly from the roads concerned. Being taken thus at random, the results may be accepted as fairly representative of American practice.

Attention should be directed to the fact that the performance of the 10-30 E, Consolidation locomotive on the Lehigh Valley Railroad in 1871 is practically equal to that of the latest Mallet compounds on the Great Northern Railway. In other words, in the ratio between the ability to produce steam and the weight on the drivers, there has been no change in the last forty years. This would indicate that the figures are not likely to be changed much as long as steam-driven locomotives are in use. What will obtain with the introduction of electric traction is "another story."

| Item No. | Length of grade, in miles. | Rate of grade. | Maximum curvature. | Compensation. | Gross weight of load, in tons. | Weight of tender, in tons. | Weight of locomotive, in tons. | Weight on drivers, in tons. | Percentage of weight on drivers utilized in draft. | Class. | Maker. | Railroad. | Year. | Source of Data. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.06 | 0.066 | ...... | .... | 115 | .. | 37.5 | 29 | 0.330 | 8-28⅓ C | Baldwin. | Morgan's Louisiana & Texas | 1880 | Baldwin Catalogue, 1881, p. 134 | |
| 2 | 0.33 | 0.0203 | 25° 20′ | .... | 242 | 25 | 35 | 23 | 0.285 | 8-28 C | " | Long Island | 1878 | " " 1881, " 72 | 10 miles per hour. |
| 3 | 1.0 | 0.06 | 16° | 0.05 | 192 | 22 | 57.5 | 50 | 0.310 | 10-36 E | " | Atchison, Topeka & Santa Fe | 1879 | " " 1881, " 115 | 8 " " " Stops and starts on grade. |
| 4 | 1.3 | 0.0127 | ...... | .... | 600 | 16 | 40 | 32.5 | 0.300 | Mogul. | " | Chillan & Talcahuana | 1879 | " " 1881, " 100 | |
| 5 | 1.4 | 0.0128 | 3°12′ | .... | 750 | 15 | 51 | 44 | 0.270 | 10-34 E | " | Chicago, Burlington & Quincy | 1880 | " " 1881, " 116 | Stops and starts at any point on grade. |
| 6 | 2.0 | 0.01 | ...... | .... | 1 000 | 15 | 51 | 44 | 0.291 | 10-34 E | " | Chicago, Burlington & Quincy | 1880 | " " 1881, " 116 | |
| 7 | 2.2 | 0.013 | 3° | .... | 725 | 15 | 51 | 44 | 0.245 | 10-34 E | " | Chicago, Burlington & Quincy | 1880 | " " 1881, " 116 | |
| 8 | 2.5 | 0.0144 | 6° | .... | 400 | 27 | 42 | 32 | 0.237 | 10-32 E | " | St. Louis & San Francisco | 1879 | " " 1881, " 87 | |
| 9 | 2.5 | 0.004 | ...... | .... | 2 700 | 70 | 96.7 | 85.8 | 0.207 | H 6 - A | Pa. R.R. | Cumberland Valley. | 1910 | ........ | |
| 10 | 3.5 | 0.033 | 14° | .... | 100 | 25 | 35 | 35 | 0.160 | ........ | ........ | ........ | .... | Trautwine's Pocket Book, Ed. 1882, p. 412 | Empty cars; many curves and reversions. |
| 11 | 3.6 | 0.035 | 10° | 0.05 | 236 | 22 | 57.5 | 50 | 0.245 | 10-36 E | Baldwin. | Atchison, Topeka & Santa Fe | 1879 | Baldwin Catalogue, 1881, p. 114 | |
| 12 | 4 0 | 0.0085 | 4° | .... | 1 020 | 30 | 51 | 44 | 0.256 | 10-34 E | " | Missouri Pacific | 1880 | " " 1881, " 112 | |
| 13 | 6 0 | 0.0145 | ...... | .... | 308 | 25 | 38 | 28 | 0.207 | 10-28 D | " | Western Maryland. | 1878 | " " 1881, " 86 | 12 miles per hour. |
| 14 | 6.0 | 0.020 | 10° | 0.05 | 460 | 32 | 57.5 | 50 | 0.242 | 10-34 E | " | Atchison, Topeka & Santa Fe | 1879 | " " 1881, " 114 | 8 " " " |
| 15 | 7.5 | 0.002 | ...... | C | 6 152 | 86 | 134 5 | 109.5 | 0.243 | Mallet. | " | Virginian Ry | 1910 | *Engineering News*, Jan. 13, 1910. | |
| 16 | 9.75 | 0.018 | ...... | .... | 200 | 18 | 29 | 29 | 0.170 | ........ | ........ | Pennsylvania | .... | Trautwine's Pocket Book, Ed. 1882, p. 412 | |
| 17 | 10 0 | 0.006 | ...... | C | 6 173 | 86 | 299 | 265 | 0.203 | Mallet. | Baldwin. | Virginian Ry | 1910 | *Engineering News*, Jan. 13, 1910. | Road locomotive and helper. |
| 18 | 12 0 | 0.018 | 10° | .... | 280 | 30 | 51 | 44 | 0 160 | 10-34 E | " | Lehigh Valley, Wyoming Div | 1871 | Baldwin Catalogue, 1881, p. 112. | |
| 19 | 12.0 | 0.022 | ...... | .... | 850 | 74 | 175 | 156 | 0.166 | D-D 16 | " | Great Northern | 1908 | Baldwin Loco. Wks. Record, No. 65, p. 29 | |
| 20 | 13.0 | 0.022 | ...... | .... | 800 | 74 | 177 | 158 | 0.153 | D-D 1 | " | Great Northern | 1908 | Baldwin Loco. Wks. Record, No. 65, p. 23 | |
| 21 | 13.0 | 0.022 | 14° | .... | 415 | 50 | 91 | 83 | 0 154 | Consol. | " | Baltimore & Ohio | 1910 | ........ | Very crooked line. Uncompensated. |
| 22 | 16.0 | 0.0044 | ...... | .... | 9 500 | 30 | 51 | 44 | 0.164 | 10-34 E | " | Central of N. J | 1880 | Baldwin Catalogue, 1881, p. 113. | |
| 23 | 20.0 | 0.022 | ...... | .... | 500 | 62 | 97.5 | 90 | 0.170 | F-8, Consol. | " | Great Northern | 1908 | Baldwin Loco. Wks. Record, No. 65, p. 29 | |
| 24 | 20.0 | 0.022 | ...... | .... | 800 | 74 | 177 | 158 | 0.159 | L-1, Mallet. | " | Great Northern | 1906 | Baldwin Loco. Wks. Record, No. 65, p. 23 | |

TABLE I.

These results have also been plotted and are presented in Fig. I, with the lengths of grade as abscissas and the percentages of weight utilized as ordinates. The curve sketched to represent a general average will show the conditions at a glance. The

* From the Proceedings of the Amer. Soc. Civil Engineers, April, 1910. The paper, of which a liberal extract is here given, was not presented at any meeting.
† "The Economic Theory of Railroad Location," 1887 Edition, p. 502.
‡ *Transactions*, Am. Soc. C. E., Vol. L, p. 1.

results may at first sight seem irregular, but the agreement is really remarkable when the variety of sources is considered; that in many cases the "reputed" rate of grade is doubtless given without actual measurement; that the results also include momentum, the ability to utilize which depends on the conditions of grade, alignment, and operating practice which obtain about the foot of each grade; and that the same amount of energy due to momentum will carry a train further on a light grade than on a heavy one.

There are four items in Table 1 which vary materially from the general consensus. For Item 9, the authorities of the road particularly state that their loads are light, because, owing to the congested condition of their business, their trains must make fast time. Item 10 represents very old practice, certainly prior to 1882, and is "second-hand." The load consisted of empty coal cars, and the line was very tortuous, so that it is quite probable that the resistance assumed in the calculation is far below the actual. Items 15 and 17 are both high. To account for this, it is to be noted that this road has been recently completed, regardless of cost in the matter of both track and rolling stock, and doubtless represents the highest development of railroad practice. Its rolling stock is all new, and is probably in better condition to offer low resistance than it will ever be again, and there were no "foreign" cars in the trains considered. The train resistance, therefore, may be naturally assumed to be much less than that of roads hauling all classes of cars, many of which are barely good enough to pass inspection. As the grades are light in both cases, this feature of train resistance is larger than in items including heavier grades. Attention should be called to the fact that a line connecting the two points representing these items on Fig. 1 would make only a small angle with the sketched curve, and would be practically parallel to a similar

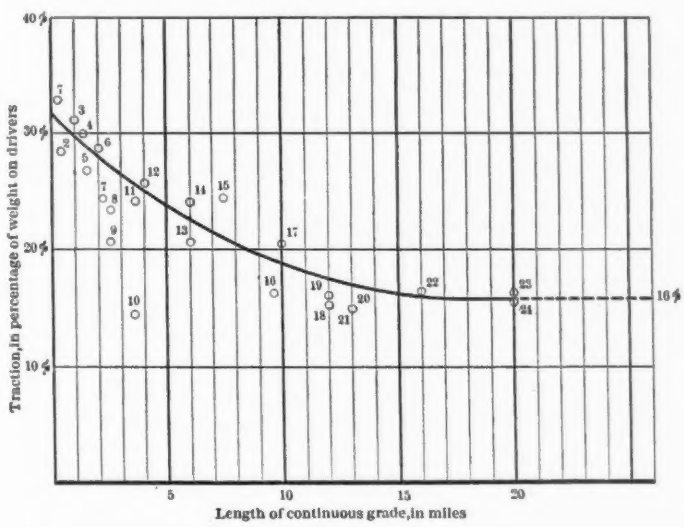


FIG. I.

line connecting the points represented by Items 13 and 16. There is, therefore, an agreement of ratios, which is all that needs consideration in this discussion.

Wellington, in his monumental work on railway location, presents a table of this character. The percentages of weight on the drivers which is utilized in draft show the greatest irregularity. He does not give the length of the grades considered, so that it is impossible to say how far the introduction of this feature would have contributed to bring order out of the chaos. In his discussion of the table he admits the unsatisfactory character of the results, and finally decides on 25 per cent. as a rough average, "very approximately the safe operating load in regular service." He further states that a number of results, which he omits for want of space, exceeds 33 per cent. The highest shown in Table 1 will be found in Item (0.06 mile, 0.066 grade), showing 33 per cent. There is no momentum effect here, as the grade is a short incline extending down to the river, and the start is necessarily a "dead" one. The reports of Item 3, which shows 31 per cent., and Item 5, which shows 27 per cent., state specifically that the locomotive will stop and start the loads given at any point on the grade.

The results of a series of experiments reported by A. C. Dennis in his paper, "Virtual Grades for Freight Trains," previously referred to, indicate a utilization of somewhat more than 23 per cent., decreasing with the speed.

All this indicates that the general failure of locomotives to utilize more than from 16 to 18 per cent. on long grades, as shown by Table 1, can only be due to the failure of the boilers to supply the necessary steam. While the higher percentage shown for the shorter grades may be ascribed largely to momentum present when the foot of the grade is reached, the energy due to stored heat is responsible for a large portion of it.

When a locomotive has been standing still, or running with the steam consumption materially below the production, the pressure accumulates until it reaches the point at which the safety valve is "set." This means that the entire machine is heated to a temperature sufficient to maintain this pressure in the boiler. When the steam consumption begins to exceed the production, this temperature is reduced to a point where the consumption and production balance.

The heat represented by this difference in temperature has passed into the steam used, thus adding to the energy supplied by the combustion going on in the furnace. The engines, therefore, are able to do considerably more work during the time the pressure is falling than they can do after the fall has ceased.

The curve in Fig. 1 would indicate that the energy derived from the two sources just discussed is practically dissipated at 15 miles, though the position of the points representing Items 16, 18, 19, 20 and 21 would indicate that this takes place more frequently between 10 and 12 miles. From this point onward the performance depends on the efficiency of the steam production, which does not appear to be able to utilize more than 16 per cent. of the weight on the drivers. The diagrams presented by Mr. Dennis in his paper on virtual grades, and by John A. Fulton, M. Am. Soc. C. E., in his discussion of that paper, indicate that similar results would be shown were they extended to include the distance named.

From this it would appear that a locomotive is capable of hauling a larger train on grades less than 10 miles in length than on longer grades, and that, even when unexpectedly stopped it is capable of starting again as soon as the steam pressure is sufficiently built up. Conversely, it should be practicable to use a higher rate of ascent on shorter grades on any given line without decreasing the load which can be hauled over it. In other words, what is known as the "ruling grade" is a function, strictly speaking, of the length as well as the rate of grade.

Shops Not Attractive to Educated Boys.—There does not seem to be any unity of action throughout the country to produce more mechanics in a systematic way, and too little earnest thought has been given to make the machine shops in particular attractive to the American educated boy. One of the chief reasons, I believe, is that the wages offered to an apprentice boy under modern conditions are entirely too low, and we often get our labor supply from the emigrant office and the street instead of from the graduating class of the American schools.—*B. M. W. Hanson before the Hartford Manufacturers' Association.*

Test Your Steam Gauges Regularly.—There was a recent locomotive boiler explosion in the yards of the National Lines of Mexico at Monterey, killing nine men, including the engineer and the night roundhouse foreman. The entire firebox end was blown off, shearing the double row of rivets in the barrel of the boiler, the crown sheet being torn across, and the fire box and outer shell were found 100 yards away. The boiler was built in 1897, but the sheets were apparently in good condition. It is generally believed that the cause was excessive pressure, as it is known that the steam gauge was out of order, and perhaps the safety valves also.

# How Burning Screenings Affected the Shop Output---and Why.

IN A SHOP WHERE THE MACHINES ARE ALL BELTED TO A LINE SHAFT, ANY VARIATION IN THE SPEED OF THE SHAFT IS OF COURSE ACCOMPANIED BY A CORRESPONDING VARIATION IN THE OUTPUT OF THE TOOLS. IN ONE SHOP THE SUBSTITUTION OF SCREENINGS FOR LUMP COAL IN THE POWER PLANT REDUCED THE LINE SHAFT REVOLUTIONS OVER 26 PER CENT. THE AUTHOR EXPLAINS THE CAUSE AND HOW IT WAS CORRECTED.

By V. T. K.

A certain locomotive repair shop has in its power house four return tubular boilers rated at 100 horsepower each. Lump coal had been burned under these boilers up to last winter, when an order came that thereafter screenings would be furnished exclusively. A change to finer grates was the only alteration made in the boilers.

A fair trial soon made it clear that with this fuel the boilers would not furnish sufficient steam to run the plant to its full capacity. The line shaft of the machine shop had been running 208 revolutions a minute, but now the boilers at the very best would only furnish sufficient steam to run it 160; in fact, when the peak load came on it often dropped as low as 95 revolutions a minute. A careful study of the whole plant soon revealed the trouble, which proved to be where the average head of a locomotive repair shop would hardly look for it.

In the first place, it was found that the boilers had been working under a load above that of their rated capacity before the change in coal took place. From the records it is known there was 3,904 lbs. of coal burned per hour under the boilers previous to the change in coal. The ordinary grades of coal obtained were of the cheap variety, having a heat value of only 10,430 B. t. u. per pound. Steam at 150 lbs. gauge contains 1,194 B. t. u. per pound. Allowing 60 per cent. boiler efficiency there will be evaporated $(10430 \times 60) \div 1194 = 5.24$ pounds of water per pound of coal as fired giving $(3904 \times 5.24) \div 30 = 683$ boiler horsepower developed by that amount of coal. The boilers, therefore, have been worked 70 per cent. over their rated capacity.

The grate area of the four boilers, as first installed, was 140 square feet, but this was subsequently shortened by some one that thought he knew what he was about. Probably he heard somewhere that by reducing the grate area a hotter fire could be had, but lost sight of the fact that the draft must be increased in order to force the required supply of air through the reduced grate area, which in this case could not be obtained unless the stacks were made higher or some mechanical draft resorted to. The air space between fingers of the grates was 36 square feet, and after the alteration of the grate, 28 square feet; the area had been altered just the opposite to what it should have been. The draft in the furnace before the change in fuel had been .31" of water and the corresponding velocity in feet per second 35, while, after the change to the fine coal the draft was .18" of water and the corresponding velocity 25 feet per second. The amount of air entering the furnace through the grates before the change amounted to $35 \times 60^2 \times 36 \times .60 = 2{,}721{,}600$ cu. ft. per hour, and after the change it was 1,307,840 cu. ft. per hour; the amount of air required for complete combustion of that amount of coal should be $3904 \times (34 \div .0747) = 1{,}776{,}320$ cu. ft. per hour, that reduced the draft power

$$\frac{1{,}776{,}320 - 1{,}307{,}480}{1{,}776{,}320} = 26\%$$

Consequently the boiler horsepower was reduced in the same proportion, or

$$683 \times .26 = 177 \text{ H.P.}$$

And also the speed of the line shaft in the machine shop would be reduced to $208 - (208 \times .26) = 154$ rev. per min., which comes close to what the average speed actually was.

Now, these figures are theoretical; the actual supply of air to the furnace through the grate was a good deal less at times, as was evidenced by the speed of the line shaft falling off to 95. This can be accounted for with the reasoning that the screenings did not have a heat value of 10,430 B. t. u., and that over 60 per cent. of the screenings being nothing but fine coal dust, which packs very readily, closing up the air space, thereby decreasing the number and the size of the voids in the bed of fire to practically nothing at the instant the fire was being fed, and not until the volatile matter had been distilled off enough to render the solid matter porous, did the air gain access to the furnace.

The result of this condition in the power house, which of course was corrected as soon as it was definitely located, was to increase the time and cost of the whole output of the shop in the same ratio. A machine job which previously had taken an hour would take about 15 minutes longer and cost 46¼ cents instead of 38 cents. A locomotive which was scheduled for 15 days would require 19 days unless overtime was resorted to. The actual results did not always show just this variation, as the shop was not exactly balanced, but the general effect was to increase the time and cost about 26 per cent.

## STEAM TURBINE ELECTRIC LOCOMOTIVE.

On the main lines of the Caledonian and North British Railways, a steam turbine electric locomotive, built for this company by the North British Locomotive Co., Ltd., from the designs of Mr. Hugh Reid, has recently undergone preliminary trials. This locomotive was briefly described by Mr. Reid in his presidential address to the Glasgow University Engineering Society of last year, as follows:

"Steam is generated in a boiler of the ordinary locomotive type, which is fitted with a superheater, and the coal and water supplies are carried in the side bunkers and side water tanks at both sides of the boiler. The steam from the boiler is led to a turbine of the impulse type running at a speed of 3,000 revolutions per minute, to which is directly coupled a continuous-current variable voltage dynamo. The dynamo supplies current and pressures varying from 200 to 600 volts to four series-wound traction motors, the armatures of which are built on the four main or driving axles of the locomotive. The exhaust steam from the turbine passes into an ejector condenser ,and is, together with the circulating condensing water, delivered eventually to the hotwell. As the steam turbine requires no internal lubrication, the water of condensation is free from oil, and consequently is returned from the hotwell direct to the boiler by means of a feed pump. The water evaporated by the boiler is therefore returned to the boiler again and again, and the supply of water carried in the tank is actually circulating water for condensation purposes. This condensing water is circulated within practically a closed cycle by means of small centrifugal pumps driven by auxiliary steam turbines placed alongside the main turbine and dynamo. The cycle of the condensing water is from the tanks through the first pump, then through the condenser, where it becomes heated in condensing the exhaust steam, then to the hotwell. From the hotwell it passes through the second pump to the cooler, situated in front of the locomotive, where the full benefit of the blast of air caused by the movement of the locomotive, aided by a fan, is utilized for cooling the hot circulating water. After passing through the cooler, the water is returned to the supply tanks ready for further service.

"The condensation of the exhaust steam deprives the locomo-

tive boiler of the usual exhaust blast which induces the draft through the fire-box and boiler tubes. In the experimental locomotive the induced draft is replaced by forced draft provided by means of a small turbine-driven fan. The fan is placed within the cooler, so that it will deliver hot air to the boiler fire, and at the same time assist the current of air through the cooler. The small switchboard and the instruments required, the controller for grouping the four motors in series—series parallel and parallel, according to the draw-bar pull to be exerted—and the regulator for controlling the voltage in the electrical circuit, and consequently the speed of the train, are all placed on the driver's platform within easy reach.

"The foregoing comprises the main and auxiliary machinery of this experimental locomotive. The whole is mounted upon a strong underframe, which is carried upon two eight-wheeled compound trucks so constructed that they will easily negotiate curves. Each truck carries two of the four driving motors already referred to. As the engine is intended for express passenger main line work, it is hoped to obtain comparisons from its actual working with the performances of the reciprocating steam locomotives, especially as regards the relative consumption of fuel and water, and also as to the efficiency of transforming the energy of steam into draw-bar or train pull, as well as the relative rapidity of acceleration under the old and new systems.

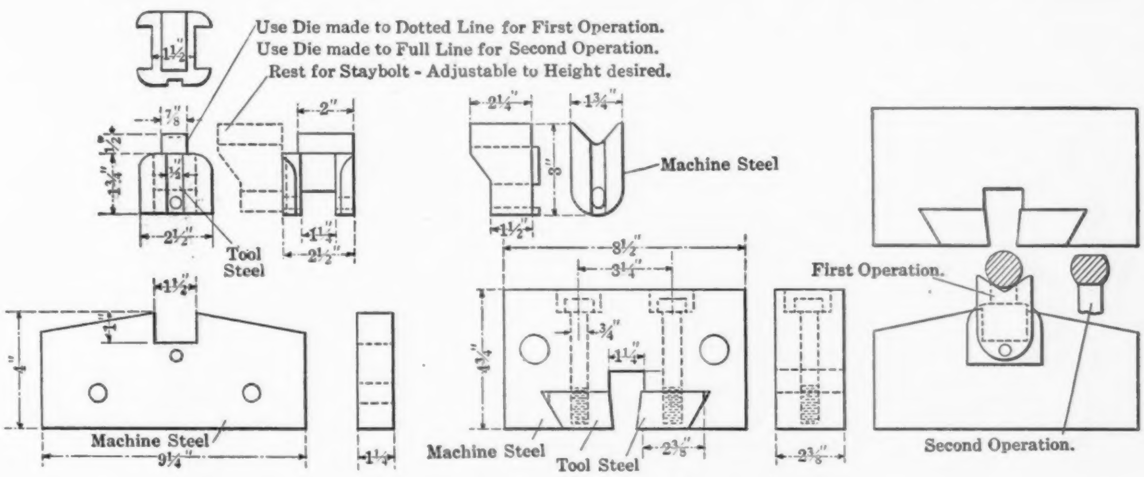
"Most of the component parts of this steam turbine electric locomotive have already proved themselves effective and efficient in other applications, and the novelty lies in the combination of the different elements of which the locomotive is composed. The expected results in this case should not, therefore, be so problematical as in an invention where the novelty is in the details, and it is the question of the cost of the locomotive which most troubles the patentees or raises any doubt as to its free adaption. It is only when the attempt is made to substitute an electric for a steam locomotive that we realize at what a very moderate first cost the steam locomotive can now be produced in up-to-date establishments with modern machinery and scientific organization in comparison with any arrangement involving the use of expensive electrical apparatus."

## DIES FOR SHEARING SQUARES ON STAYBOLTS.

At the Readville shops of the New York, New Haven & Hartford Railroad a set of dies have been devised for application to a Hilles & Jones No. 2 shear, which permits the cold shearing of the squares on the ends of staybolts being done in a very rapid and satisfactory manner.

Two sides of the squares are sheared in the first operation by cutters of small inserted tool steel pieces set into a head of the proper shape, which is secured to the shear head. These cutters are 2⅜ in. in length and are set apart the proper distance for the squares desired. Of course, the length of the square can be anything desired up to the length of the cutters. On the lower plate of the shear is a holder for steadying the bolt during the operation, which is provided with two styles of support, one for cutting the first two faces, which is hollowed out to fit the round part of the bolt, and the other flat on top to insure the faces being at 90 degs. and used when cutting the other faces.

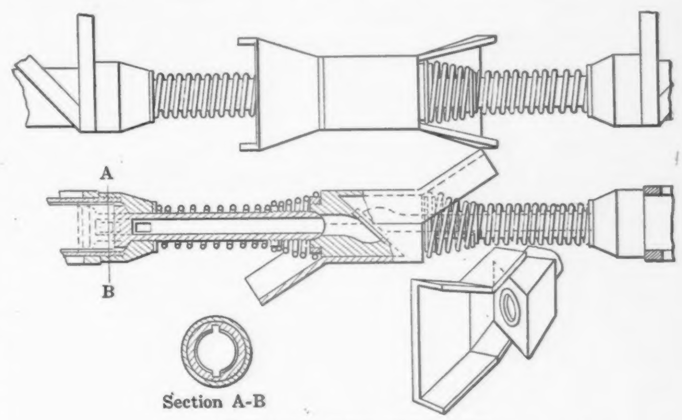
With this arrangement the ends of 100 staybolts can be squared in an hour.




DETAILS OF DIES FOR SHEARING SQUARE ENDS ON STAYBOLTS.

## AUTOMATIC AIR HOSE CONNECTOR.

A new design of automatic air hose connector has been patented by Howard W. Thomas, of Charleroi, Pa., that differs in many particulars from any of the designs now existing. Reference to the illustration will readily show the general features of this arrangement, which uses the trough scheme for centering the head and an inclined face for the abutting connectors. This connector also automatically closes off the air when uncoupled

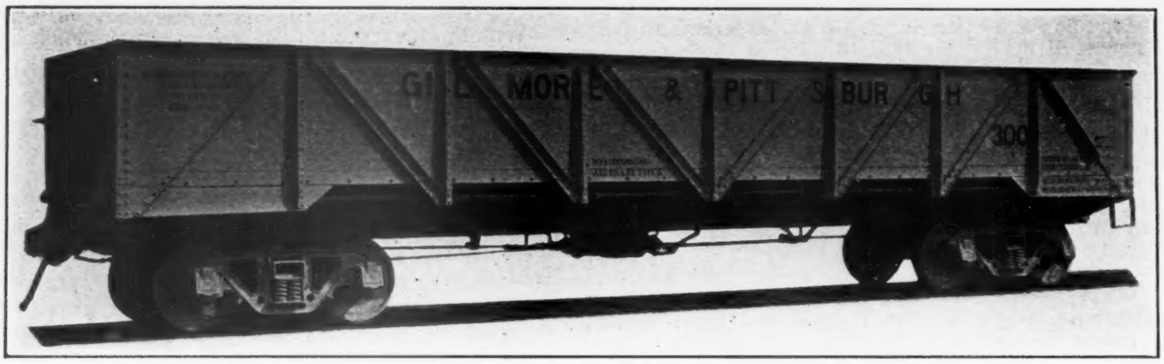



AUTOMATIC HOSE CONNECTOR.

and in many particulars is the lightest and simplest arrangement that has been designed.

In its essential features it consists of a tubular stem guided by a flange on the end of the train pipe, this stem having an enlarged end guided inside of the train pipe by two lips sliding in grooves, to prevent its turning, which acts as a stop and also as a valve for closing off the air. When this stem is forced in sufficiently, ports in its side permit the passage of air from the train line. It is held outward by a coil spring resting between the end of the train line and the flange screwed to the stem. At its other end it has a ball joint connection to the head, allowing the latter to move freely in any direction, although the spring which holds the head in place tends to keep it central. The head includes the trough guide which has a horizontal face for a short distance, then inclines at an angle of 45 degs. outward, the perspective view showing this arrangement very clearly.

The whole apparatus, except the heads, is rigid, being supported by a hanger from the coupler shank and all vertical or lateral motion is taken up by the ball joints of the head.



DROP BOTTOM GONDOLA CAR WITH A NEW ALL STEEL TRUCK.

## DROP BOTTOM GONDOLA CAR WITH A NEW CAST STEEL TRUCK.

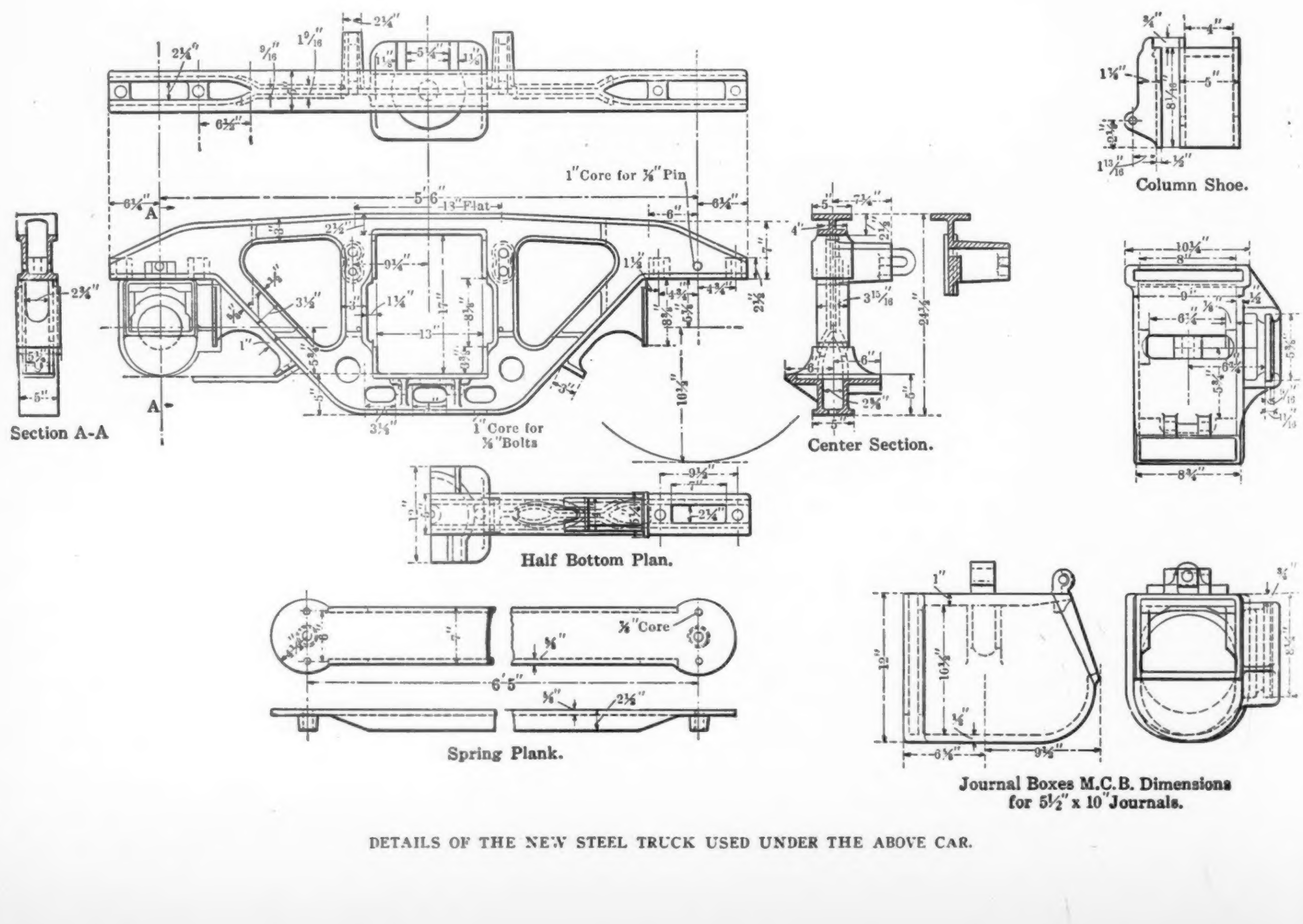
The Western Steel Car & Foundry Co. has recently completed for the Gilmore & Pittsburgh one hundred 50-ton composite gondola cars of the general service type. These cars have a single center sill with a trussed side frame built up of standard sections for the tension and special sections for the compression members. The floor consists of 10 drop doors covering the full length of the car and arranged to discharge the load at the sides. The doors on either side may be operated independently and it requires but three or four minutes to discharge the whole load and close the doors. The ends are arranged to drop inward, so that the car can be used for loading long material.

Under these cars a truck is used which, in addition to having a cast steel side frame and bolster, has also cast steel journal boxes and a cast steel spring plank. The truck frame contains no bolts, although the journal boxes are cast separate from the side frame. Provision is made in the frame for the application of column bolts and a tie bar in case it becomes necessary to apply an ordinary malleable or cast iron journal box for temporary repairs. On the side frame, the details of which are clearly shown in the line drawing, are included wings with an extension face, over which a recessed extension on the inside of the journal box fits. On top of the journal box is a lug that extends up through an opening in the side frame and a ⅞ in. pin slips through both and holds the box in place, no other fastening being provided. At the bottom of these wings are extensions, to which a temporary tie bar can be secured when necessary.

On the cast steel spring plank there are two lugs, one on either end, 2½ in. in diameter and 1⅞ in. deep, that set into cored openings at the bottom of the side frame. These lugs are tapered and provide the necessary fastening between the lower sections of the two side frames. The spring plant is a steel casting of channel shape with the wings cut away at the ends, as shown in the illustration.

On the columns of the side frames, removable filler blocks or cheek plates have been provided. These cheek plates permit the bolsters to be placed or removed without jacking up the car or taking out the spring plank, and they also take a considerable portion of the service wear from the truck side frame column faces. This construction is an invention of W. P. Richardson, mechanical engineer, Pittsburgh & Lake Erie Railroad.

This truck is manufactured by the Pittsburgh Equipment Co, House Bldg., Pittsburgh, Pa.




DETAILS OF THE NEW STEEL TRUCK USED UNDER THE ABOVE CAR.

The general dimensions of these cars are as follows:

| | |
|---|---|
| Height from rail to top of body | 8 ft. 11 in. |
| Height from rail to top of floor | 4 " 7 " |
| Depth of car body | 4 " 4 " |
| Length inside of body | 41 " 9 " |
| Length over end sills | 43 " 2⅝ " |
| Width inside of body | 9 " 2½ " |
| Width over side stakes | 10 " 2 " |
| Length of drop door openings, 4 doors | 4 " 9 " |
| 12 doors | 4 " 10 " |
| Width of drop door openings | 4 " 0½ " |
| Distance from center to center of trucks | 31 ft. |
| Truck wheel base | 5 ft. 6 in. |
| Capacity | 50 tons |
| Weight | 41,803 lbs. |
| Ratio of paying freight to total weight loaded car | 72.5 per cent. |

Special equipment used is as follows:

| | |
|---|---|
| Brakes | Westinghouse |
| Brake beams | Damascus, Waycott |
| Couplers | Climax |
| Coupler operating device | Carmer |
| Draft rigging | Westinghouse friction |
| Nut locks | Bartley |

## SERVICE OF CONVERTED MALLET LOCOMOTIVE.

GREAT NORTHERN RAILWAY.

About a year ago the Great Northern Railway converted a large consolidation locomotive into a Mallet compound by the removal of the front truck and the addition of an entire new front unit, furnished by the Baldwin Locomotive Works. This made a locomotive of the 2-6-8-0 type, which has since been in service hauling ore from the mines at Kelly Lake to the docks at Allouez, just outside of Superior. The consolidation locomotive was previously in the same service and handled 70 cars of average 63 tons each, or a total tonnage of 4,410 beind the tender. This service was performed with a consumption of 10 lbs. of coal per 100 ton miles. The converted locomotive is handling 6,615 tons or 105 cars with an average consumption of 7 lbs. of coal per 100 ton miles, or but a slightly greater total coal consumption with 50 per cent. greater tonnage.

The original consolidation locomotive had the following general dimensions:

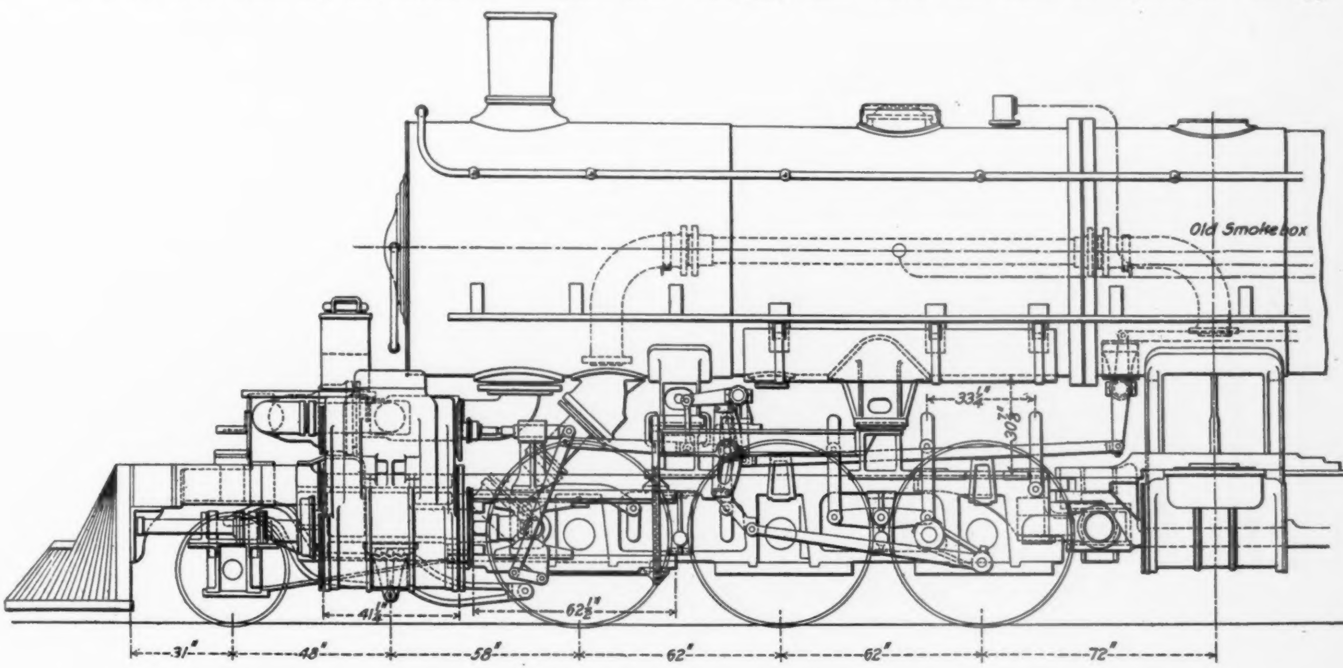
| | |
|---|---|
| Cylinders | 20 in. x 32 in. |
| Driving wheels, diameter | 55 in. |
| Boiler, diameter | 74⅛ in. |
| Steam pressure | 210 lbs. |
| Total heating surface | 2,727 sq. ft. |
| Grate area | 59 sq. ft. |
| Wheel base, driving | 16 ft. |
| Wheel base, total | 24 ft. 3 in. |
| Weight on driving wheels | 188,250 lbs. |
| Weight total engine | 210,350 lbs. |
| Tractive effort | 41,500 lbs. |

The front truck, bumper beam and pilot were removed and applied complete to the new front unit. A steel casting was inserted in front of the cylinders to carry the pivot pin for connecting the front group and the exhaust pipe was removed, the openings being covered by a cast iron elbow pipe that terminated in a horizontal receiver pipe passing through the center of the feed water heater, which was carried in the new extension of the boiler. The stack opening was closed with a suitable cover.

In the boiler an Emerson fire tube superheater was installed, which a later test showed to give as high as 626 degs. F. at the high pressure cylinders.

Over the front group is carried the feed water heater and an extension smoke box. An internal ring is riveted to the shell just back of the feed water heater and a similar ring was secured to the smoke box of the old locomotive, these two rings being bolted with a V-shaped fit and held together by horizontal bolts in the same manner used for other separable boilers built by the Baldwin Works. The feed water heater has 346 2-in. tubes, 8 ft. long, giving a heating surface of 1,451 sq. ft. The flue through which the receiver pipe passes is larger than the pipe itself, so that it acts somewhat as a reheater in itself.

The steam distribution on the new unit is controlled by 12-in. piston valves, operated by Walschaert valve gear. The high pressure cylinders were equipped with American Balanced Valve Company slide valves, and after the superheater was applied there was more or less trouble with the valves and seats cutting. These cast iron valves were finally replaced with a brass valve and the lubricant changed to the Galena Balanced Superheater valve oil, since which time there has been no trouble with the valves.



NEW FRONT UNIT APPLIED TO THE CONVERTED MALLET LOCOMOTIVE ON THE GREAT NORTHERN RAILWAY.

The driving wheel base of the new unit, as will be seen in the illustration, is 10 ft. 4 in. and its total wheel base 19 ft. 2 in. The total wheel base of the rebuilt locomotive is 45 ft. 8 in. and approximately 135,000 lbs. is carried on the forward group of driving wheels. Two supports, both of which normally have their surfaces in contact, carry the overhang of the boiler on the front group. Centering springs and clamps of the usual form are provided. The equalization of the forward unit is continuous on each side. Over the front driving box yoke equalizers are placed, from which are carried a transverse steel casting, which supports an inverted leaf spring. This spring is connected to the back end of the forward equalizers from the truck by a link.

The service with this experimental engine has been so satisfactory that it is probable other consolidations will soon be converted.